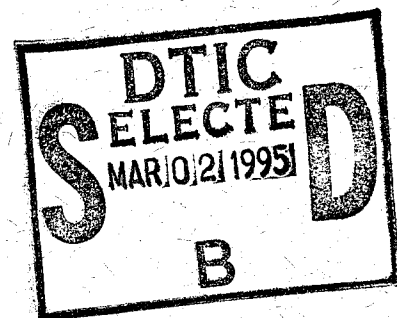
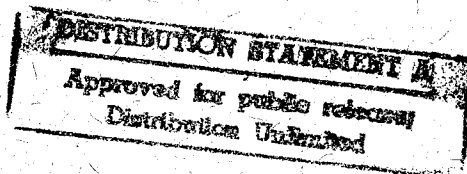

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ELMENDORF AFB, ALASKA

FINAL
FIELD SAMPLING PLAN

INSTALLATION RESTORATION
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RADAR STATION, ALASKA

OCTOBER 1994

PREPARED BY:

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NOTICE

NOTICE

This document has been prepared for the United States Air Force by Tetra Tech, Inc. to provide information regarding environmental conditions with respect to possible releases of hazardous substances at the Kotzebue Long Range Radar Station (LRRS), located 4 miles south of Kotzebue, Alaska. As the document relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the studies at Kotzebue LRRS, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known which may make this report premature or inaccurate. Acceptance of this report in performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

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1.0 INTRODUCTION

This document is the Field Sampling Plan (FSP) portion of the Sampling and Analysis Plan (SAP) for the proposed Remedial Investigation/Feasibility Study (RI/FS) being conducted by Tetra Tech, Inc. at the Kotzebue Long Range Radar Station (LRRS), located near Kotzebue, Alaska. The Field Sampling Plan and the companion document Quality Assurance Project Plan (QAPP) together comprise the SAP; these documents will be used as guidance for all field sampling activities performed at the Kotzebue LRRS site during 1994. Unless specified, the activities described in this FSP conform to the guidelines established by the Handbook to Support the Installation Restoration Program (IRP) Statements of Work, Volume 1 - Remedial Investigation/Feasibility Studies, dated May 1992, hereafter referred to as the *IRP Handbook*.

1.1 PROJECT DESCRIPTION

Tetra Tech, Inc., under contract to the United States Department of the Air Force (USAF), has been requested to conduct a RI/FS at Kotzebue LRRS, Alaska. The RI/FS will be conducted under the authority of the USAF Installation Restoration Program (IRP) and under direction of the Air Force Center for Environmental Excellence (AFCEE).

The RI/FS process includes a scoping task to define data requirements and objectives, a remedial investigation to characterize sites and support a baseline risk assessment, and a feasibility study to define and evaluate available remedial alternatives to support the selection of specific remedial actions. The RI/FS process can be conducted in stages that focus on particular aspects of each process. A Stage 1 and Stage 2 IRP RI/FS have been previously conducted at Kotzebue LRRS. However, remaining concerns regarding current site conditions necessitate further site investigation and remedial response in order to achieve environmental restoration at Kotzebue LRRS. A description of the Kotzebue LRRS, a summary of past IRP work conducted at the installation, and a description of the recent site survey conducted by Tetra Tech and Air Force personnel at Kotzebue LRRS is presented in the companion QAPP document. This information is also presented in the Draft IRP Work Plan for Kotzebue LRRS.

1.2 PURPOSE AND SCOPE

The purpose of this document is to provide procedural guidelines for all RI/FS field sampling activities. The SAP is a companion document to the Draft Work Plan, Installation Restoration Program (IRP), Kotzebue LRRS, Alaska (Tetra Tech, Inc. 1994; hereafter referred to as the Work Plan). This FSP portion of the SAP contains a discussion of the following topics:

- Site-specific field activities and sample locations
- Field operations procedures
- Environmental sample collection procedures
- Sample custody and handling
- QA/QC Program and QC sample collection
- Summary of sample analyses
- Field measurements and instrument calibration and maintenance
- Recordkeeping and site management.

2.0 SITE-SPECIFIC FIELD ACTIVITIES AND SAMPLE LOCATIONS

This section describes the site-specific RI/FS field sampling activities to be conducted at known sites, areas of concern, and at background locations at Kotzebue LRRS during the 1994 field season. Details of each field operation, including the collection of field samples, sample handling and shipment, and site management activities, are described in subsequent sections of this document.

2.1 FIELD ACTIVITIES SUMMARY

Six sites identified during previous IRP field investigations have been selected for further characterization. The sites were selected based on a review of historical site information, previous IRP RI/FS results, ADEC correspondence concerning current site conditions, and site survey information. The six sites include: 1) Site SS02-Waste Accumulation Area No.2/Landfill; 2) Site ST05-Beach Tanks; 3) Site SS07-Lake; 4) Site SS08-Barracks Pad; 5) Site SS11-Fuel Spill; and 6) Site SS12-Spills No. 2 and 3.

During September 1993, Tetra Tech and Air Force personnel conducted a site survey of the Kotzebue LRRS and surrounding areas. Ten areas of concern (AOCs) were identified during the site survey that warrant further consideration during this RI/FS field sampling effort. Figure 2-1 identifies all sites and areas of concern (AOCs) to be investigated at Kotzebue LRRS in 1994. A summary of proposed field activities for Kotzebue LRRS is provided in Table 2-1.

Proposed sample analyses to determine the nature, magnitude, and extent of contamination at sites, specifically address whether natural biodegradation is actively occurring at sites, and support an assessment of contaminant fate and transport are summarized in Section 3.2.4, Summary of Sample Analyses. A detailed description of each analytical method is provided in the QAPP portion of the SAP.

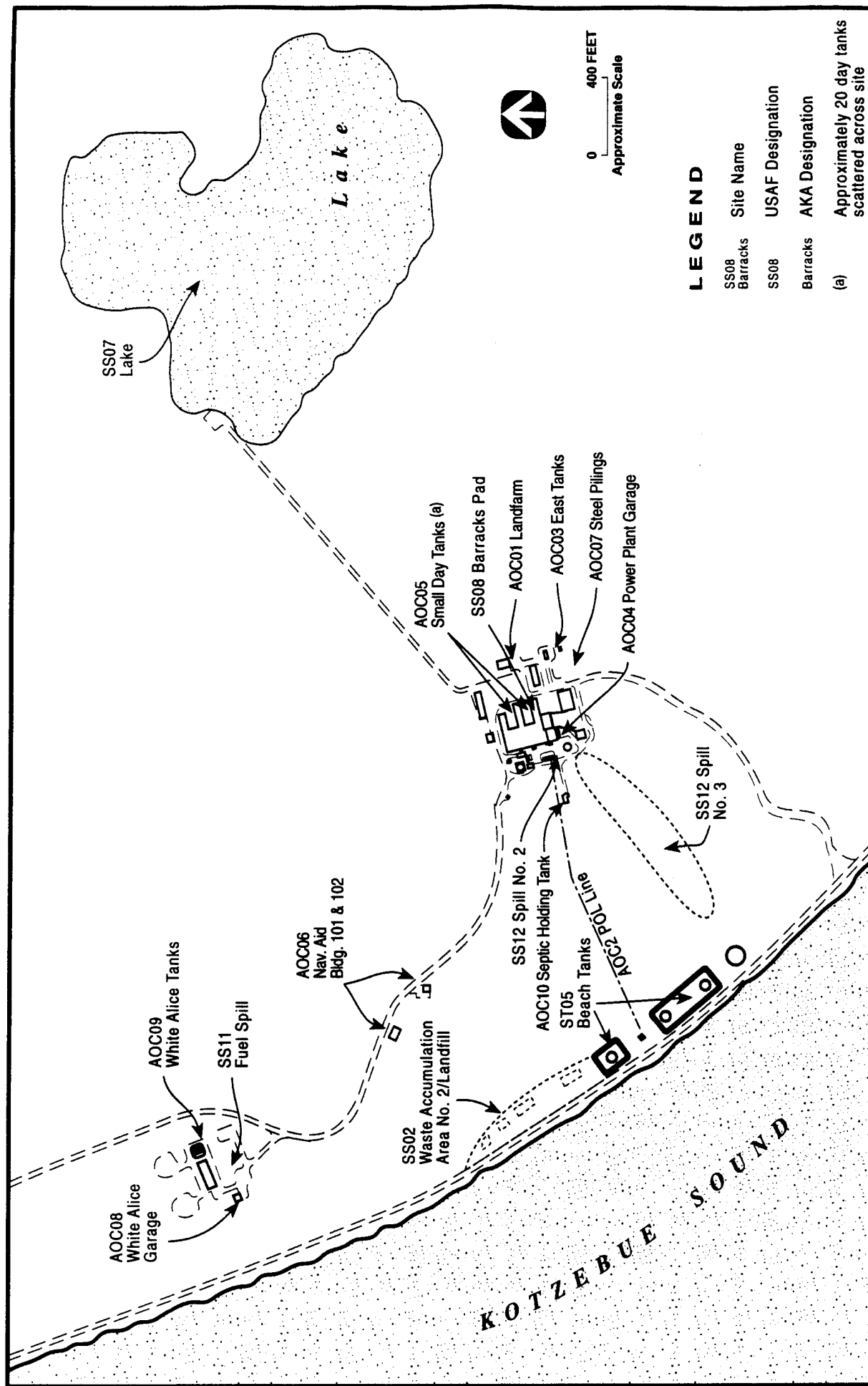


Figure 2-1. Areas of Investigation, Kotzebue LRRS, Alaska.

TABLE 2-1. SUMMARY OF PROPOSED FIELD ACTIVITIES FOR KOTZEBUE LRRS, ALASKA

Site Designation	Facilities Inspection	Field Screening	Hand Auger Sampling	Drilling and Sampling	Installing Wells	Groundwater Sampling	Surface Water Sampling	Seawater Sampling	Free Product Assessment	Tidal Influence	Aquifer Testing	Geotechnical Parameters	Gradiometer Survey	Sample Location Surveying
SS02-Waste Area No. 2/Landfill		X		X	X	X							X	X
ST05-Beach Tanks		X		X	X	X		X	X	X	X	X		X
SS07-Lake		X	X				X							X
SS08-Barracks Pad		X	X									X		X
SS11-Fuel Spill		X	X									X		X
SS12-Spills No. 2 and 3		X	X	X	X	X	X		X			X		X
AOC-1 Landfarm Landfarm Seeps		X	X											X
AOC-2 POL Lines		X	X											X
AOC-3 East Tanks		X	X											X
AOC-4 Power Plant Garage	X	X	X											X
AOC-5 Small Day Tanks		X	X											X
AOC-6 Nav. Aid Bldg.	X	X	X											X
AOC-7 Steel Pilings	X	X	X											X
AOC-8 White Alice Garage	X	X	X											X
AOC-9 White Alice Tanks		X	X											X
AOC-10 Septic Holding Tank	X	X												X
Background Characterization		X	X	X	X	X	X	X						X

2.1.1 Kotzebue LRRS Identified Sites

Six sites identified during previous IRP remedial investigations have been selected for further characterization, including: 1) Site SS02-Waste Accumulation Area No. 2/Landfill, 2) Site ST05-Beach Tanks, 3) Site SS07-Lake, 4) Site SS08-Barracks Pad, 5) Site SS11-Fuel Spill, and 6) Site SS12-Spills No. 2 and 3. Figure 2-1 is an installation map identifying the location of the six previously identified sites selected for characterization. Site investigation activities for the six sites are summarized in Table 2-1.

The following section provides a description of field activities and identifies proposed sample locations at the six sites selected for further characterization. The proposed locations and numbers of samples to be collected are estimates based on identified RI/FS data needs and a review of previous IRP investigation site survey results for Kotzebue LRRS. The proposed site-specific sample locations and numbers of samples collected may vary somewhat based on field conditions encountered during the field investigation.

2.1.1.1 Site SS02-Waste Accumulation Area No.2/Landfill. Tetra Tech proposes to investigate groundwater and soils based on the limited site-specific waste disposal information and general lack of environmental characterization information pertaining to Site SS02. Non-invasive investigative techniques will be employed to characterize soil and groundwater quality associated with the site. Figure 2-2 identifies the proposed soil and groundwater sample locations. Groundwater will be characterized down-gradient of the mounded areas between the site and Kotzebue Sound to evaluate potential contaminant migration to Kotzebue Sound. Surface soil samples will be collected from locations that exhibit signs of leaching or staining, at the base of waste mounds, and/or from areas that yield detections using field screening techniques. Additionally, Tetra Tech will determine the lateral extent of buried metallic debris present in the landfill by conducting a gradiometric survey of the area. A variety of wastes are suspected to have been stored and disposed of at this site, and field samples will be analyzed for a broad range of compounds. Field activities to be conducted at Site SS02 include:

- **Gradiometric Survey**--A gradiometric survey of the former landfill area will be conducted using a Ferro-Trak FT-60 magnetic locator. The survey will map the lateral extent of buried metallic debris. The survey will be conducted by establishing a grid oriented parallel to the long axis of the landfill and using 25-foot spacings between instrument readings. The lateral extent of buried metal debris will be identified on a site plan

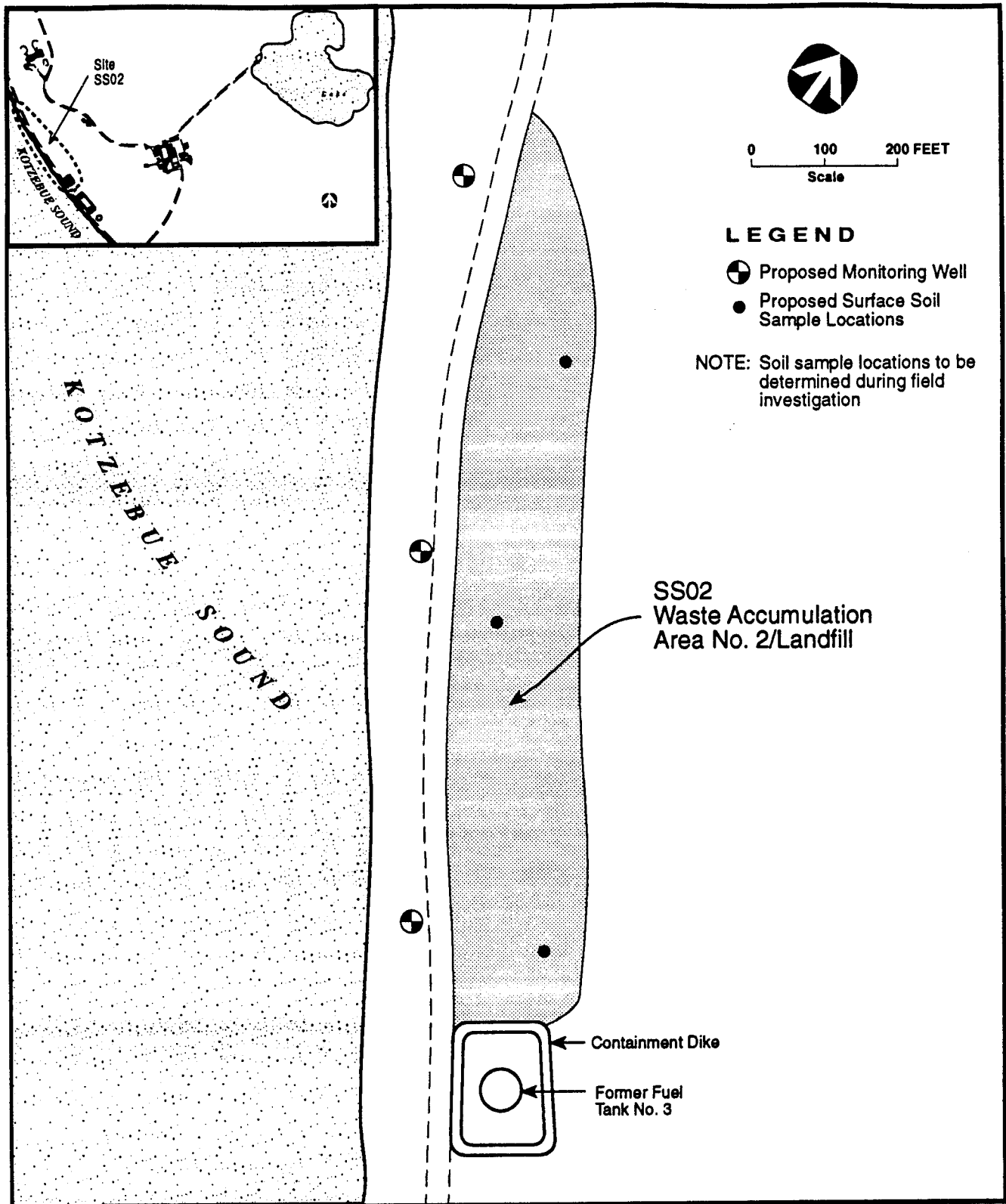


Figure 2-2. Proposed Groundwater Monitoring Well and Surface Soil Sample Locations at SS02 Waste Accumulation Area No. 2/Landfill, Kotzebue LRRS, Alaska.

together with instrument grid spacings and readings (see Section 3.1.7, Gradiometric Survey).

- ***Soil Sampling***--Three surface soil samples will be collected using procedures described in Section 3.2.1.1, Surface and Near-Surface Soil Sampling, from locations within Site SS02 that exhibit leaching or staining, are located at the base of waste mounds, and/or from areas identified using field screening techniques described in Section 3.1.2, Site Reconnaissance. The soil samples will be analyzed for residual TPH, diesel-range TPH, VOCs, SVOCs, pesticides and PCBs, and total metals.
- ***Monitoring Well Installation and Groundwater Sampling***--Three shallow groundwater monitoring wells will be installed in assumed downgradient locations between the site and Kotzebue Sound to evaluate potential contaminant migration via groundwater (see Section 3.1.4, Monitoring Well Installation and Well Development). One groundwater sample will be collected from each monitoring well as described in Section 3.2.1.7, Groundwater Sampling. The groundwater samples will be analyzed for residual TPH, diesel-range TPH, VOCs, SVOCs, pesticides and PCBs, and both total and dissolved metals.

2.1.1.2 Site ST05-Beach Tanks. Additional site characterization is needed at Site ST05 to evaluate current site conditions and to determine the nature and extent of petroleum hydrocarbon contamination. Site characterization will incorporate the collection of subsoil samples, groundwater samples, seawater samples, and will include a survey for floating hydrocarbon product. Figure 2-3 identifies proposed monitoring well and soil boring locations. In addition to contaminant characterization, geochemical, and conventional parameters will be measured in groundwater samples to evaluate the extent to which natural biodegradation is active, and to determine the degree to which biodegradation may be responsible for the reduction of contaminant concentrations in groundwater. Additional site characterization information to be collected in support of a contaminant fate and transport assessment for Site ST05 includes geotechnical parameters (e.g., permeability and grain size distribution), near-beach groundwater system characteristics (e.g., hydraulic gradients, flow direction and rate, and hydraulic conductivity), and an assessment of tidal influence on the shallow near-beach aquifer. Field activities to be conducted at Site ST05 include the following:

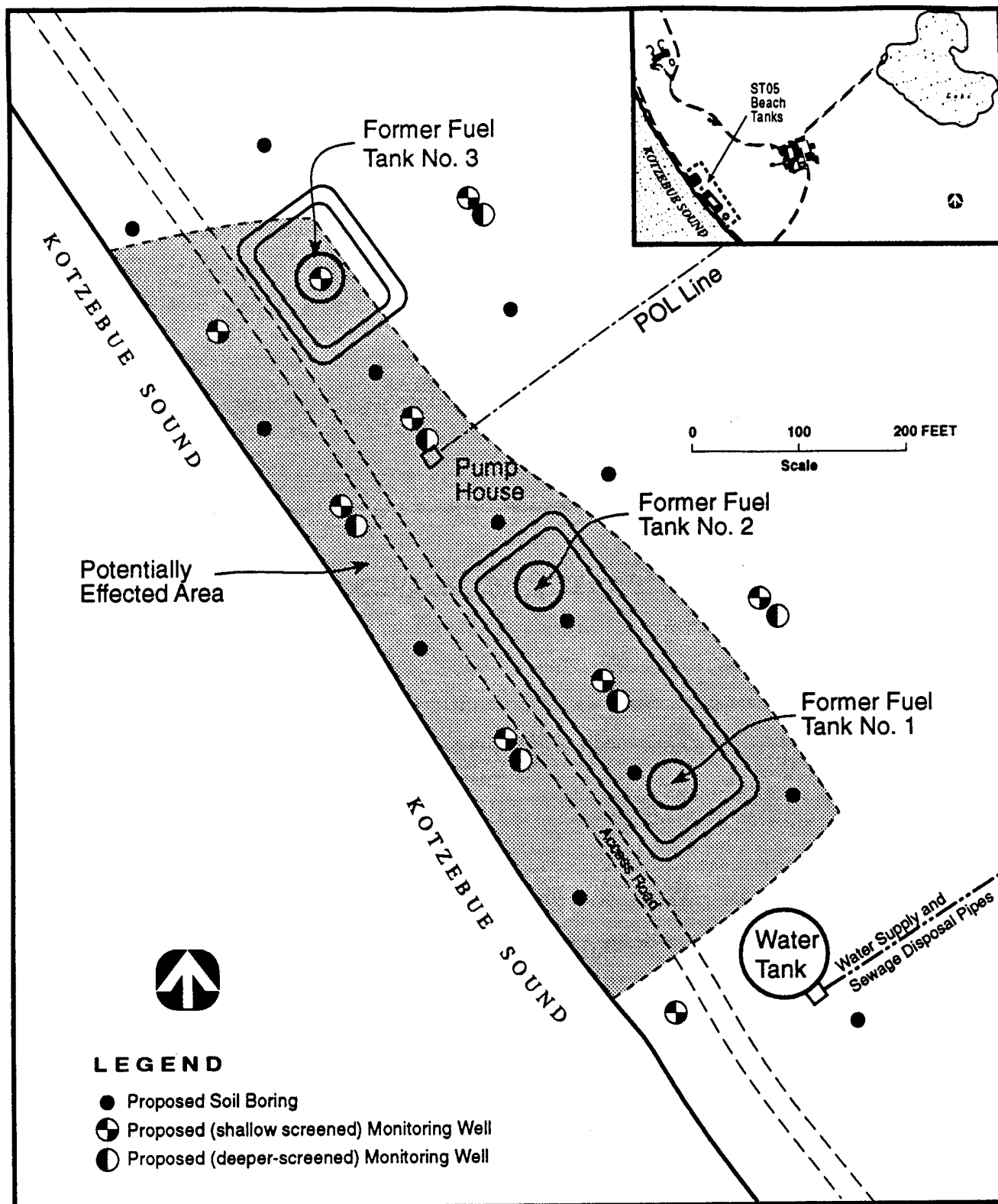


Figure 2-3. Proposed Monitoring Well and Soil Sample Locations at ST05 Beach Tanks, Kotzebue LRRS, Alaska.

- ***Subsoil Sampling***--Tetra Tech proposes to advance 22 shallow soil borings in the vicinity of the former beach tanks (see Figure 2-3). Sample cores obtained during drilling will be screened for the presence of petroleum hydrocarbons using field screening techniques, and one subsoil sample will be submitted for laboratory analysis from each boring using procedures described in Section 3.2.1.2, Subsoil Sampling. All subsoil samples will be analyzed for diesel-range TPH; ten samples will also be submitted for VOCs, SVOCs, and residual TPH analyses. Pesticides have not been previously characterized at the site. Three subsoil samples will be submitted for pesticides analysis.

- ***Monitoring Well Installation and Groundwater Sampling***--Shallow groundwater monitoring wells will be installed in nine of the 22 boreholes advanced at the ST05-Beach Tanks Site. Six additional wells will be installed at deeper depths to evaluate groundwater physical and chemical characteristics versus depth. One groundwater sample will be collected from each monitoring well installed. All groundwater samples will be analyzed for diesel-range TPH, VOCs, and SVOCs. Selected wells will also be sampled for geochemical and conventional parameters to support the natural biodegradation assessment for the site. Well installation and groundwater sampling procedures are described in Section 3.1.4, Monitoring Well Installation and Well Development and Section 3.2.1.7, Groundwater Sampling, respectively.

- ***Seawater Sampling***--Tetra Tech will collect three seawater samples from Kotzebue Sound to determine if groundwater contaminants affect the quality of seawater at the Beach Tanks Site. The samples will be collected below the water surface from near-shore locations spaced along the beach adjacent to the former fuel storage tanks using procedures presented in Section 3.2.1.8, Seawater Sampling. The seawater samples will be analyzed for diesel-range TPH, VOCs, and SVOCs.

- ***Assessment of Free Hydrocarbon Product***--Each monitoring well will be investigated for the presence of free petroleum hydrocarbons no sooner than two days after the completion of well development. The presence and thickness of free hydrocarbon product will be determined and measured using an oil/water interface probe as described in Section 3.3.6, Immiscible Product Thickness.

- **Natural Biodegradation**--A suite of geochemical parameters will be measured in groundwater samples obtained from selected monitoring wells located upgradient, in, and downgradient of the Beach Tanks pads. The relationship between groundwater geochemistry and contaminant chemistry as groundwater moves through the source area will allow a determination of the extent to which natural biodegradation may be active, and to what extent it may be responsible for reductions in contaminant concentrations in groundwater (see Section 3.3.11, Field Test Kits).
- **Tidal Monitoring**--The influence of tides on the near-beach aquifer system can directly affect aquifer hydraulic characteristics and geochemistry, influencing contaminant migration and impacting the evaluation of remedial alternatives. A data logger and pressure transducers will be installed in selected monitoring wells at shallow and intermediate depths (see Section 3.1.6, Tidal Monitoring). Tidal influences on the near-beach groundwater system will be electronically monitored for a 48-hour period to encompass four complete diurnal tide cycles.
- **Aquifer Testing**--Slug tests will be conducted in the six intermediate-depth monitoring wells installed in the vicinity of the Beach Tanks Site to evaluate aquifer characteristics associated with the Kotzebue Sound beach area (see Figure 2-3). The slug tests will consist of both rising-head and falling-head tests as described in Section 3.1.5, Aquifer Testing.
- **Geotechnical Parameters**-- Three locations have been identified for the collection of geotechnical samples, one each in the back-beach, mid-beach, and fore-beach areas. One sample will be collected from each location and submitted for grain-size analysis (ASTM Methods C136 and D442), soil permeability testing (constant-head, ASTM Method D5084), and total organic carbon (EPA Method 9060). Samples will be collected from the vadose zone just above the groundwater surface, and from the saturated zone just below the groundwater surface. Sampling will be conducted in areas determined to be free of contamination by the field sampling team; thus, the final determination of the three sampling locations will be made in the field. Shelby tubes will be used to collect

the undisturbed samples for permeability testing as described in Section 3.2.1.4, Geotechnical Sampling.

2.1.1.3 Site SS07-Lake. Tetra Tech proposes to conduct characterization of the lake to verify the presence of previously identified contamination, evaluate the magnitude and extent of contamination (if present), and evaluate potential contaminant source area(s). Figure 2-4 identifies the proposed soil, sediment, and surface water sample locations. Field activities to be conducted at Site SS07 include the following:

- ***Sediment Sampling***--Tetra Tech proposes to collect three sediment samples from the former water supply lake. One sample will be located at or near the original sample location to confirm the presence of previously detected contamination. Two additional samples will be collected to estimate the potential extent of contamination (see Section 3.2.1.5, Lake Sediment Sampling). The lake sediment samples will be analyzed for diesel-range TPH, SVOCs, pesticides and PCBs, and total metals. One sediment sample will be analyzed for the presence of VOCs.
- ***Surface Water Sampling***--Tetra Tech proposes to collect three surface water samples from the former water supply lake at locations near those selected for sediment sampling. Surface water samples will be collected prior to the collection of sediment samples to avoid the incorporation of disturbed sediment in water samples (see Section 3.2.1.6, Surface Water Sampling). All surface water samples will be analyzed for diesel-range TPH, SVOCs, and pesticides and PCBs. One water sample will be analyzed for the presence of VOCs and for both total and dissolved metals.
- ***Soil Sampling***--Tetra Tech proposes to collect two soil samples from the lake access road near the former water supply intake to evaluate the potential of road oiling as the source of previously identified lake sediment contamination. Soil samples will be collected as described in Section 3.2.1.1, Surface and Near-Surface Soil Sampling. Each soil sample will be analyzed for pesticides and PCBs.

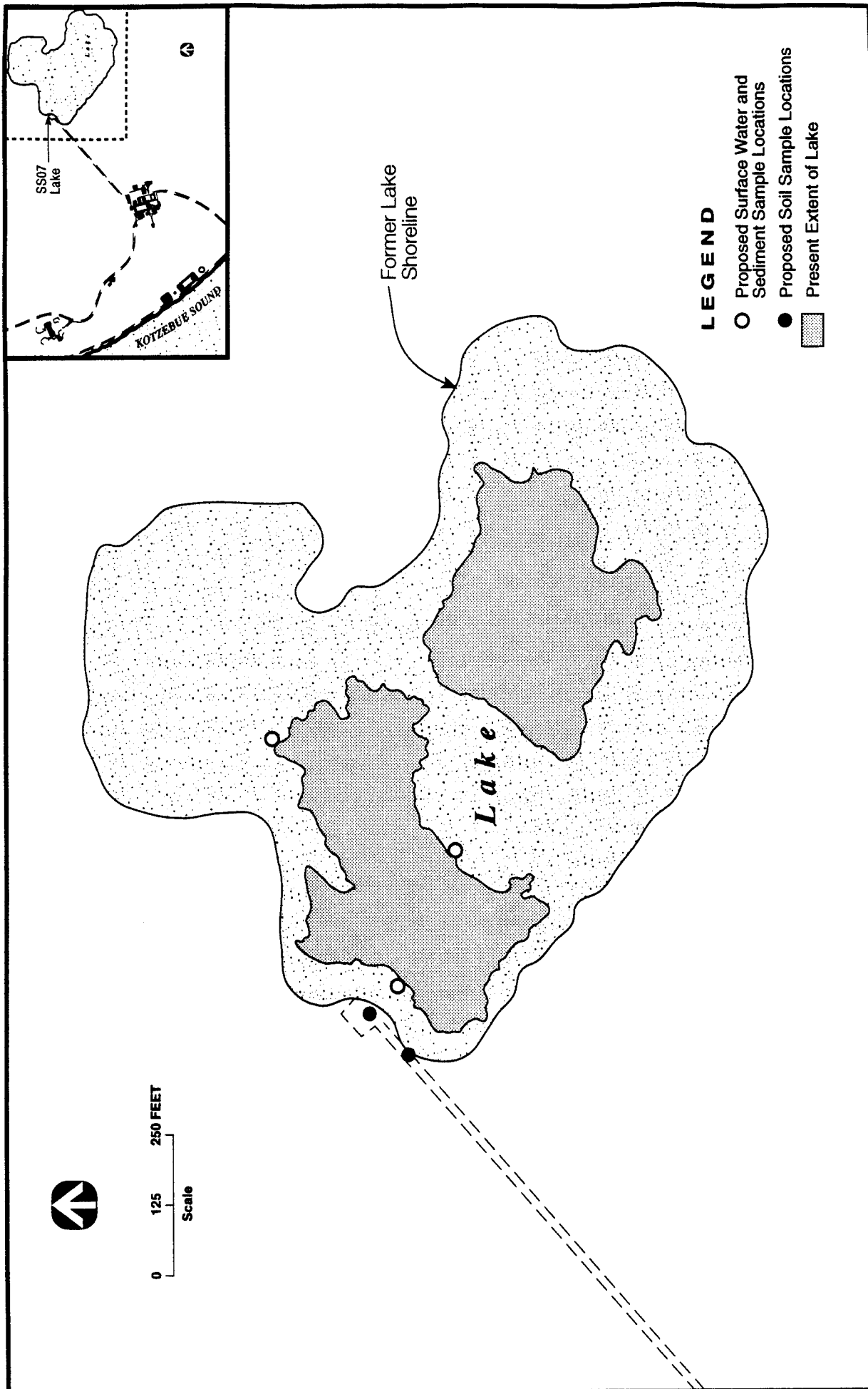


Figure 2-4. Proposed Surface Soil, Sediment, and Surface Water Sample Locations at SS07 Lake, Kotzebue LRRS, Alaska.

2.1.1.4 Site SS08-Barracks Pad. Additional site characterization at Site SS08-Barracks Pad is required to evaluate current site conditions and determine the extent of potential petroleum hydrocarbon contamination. Figure 2-5 identifies the proposed soil sample locations. Field activities to be conducted at Site SS08 include the following:

- **Soil Sampling**--Tetra Tech proposes to collect from four to eight soil samples in the vicinity of the barracks pad as described in Section 3.2.1.1, Surface and Near-Surface Soil Sampling. The soil samples will be analyzed for diesel-range TPH; three to five samples will be analyzed for VOCs, SVOCs, and pesticides and PCBs. Two soil samples will be analyzed for total metals.
- **Geotechnical Parameters**--Tetra Tech proposes to collect subsoil samples of engineered fill material and of native tundra for geotechnical testing to estimate critical parameters regarding contaminant transport in the vicinity of Site SS08. One sample each will be collected from fill material and native tundra and submitted for grain-size analysis (ASTM Methods C136 and D442), soil permeability testing (constant-head, ASTM Method D5084), and analysis of total organic carbon (EPA Method 9060). Sampling will be conducted in areas determined to be free of contamination by the field team. Shelby tubes will be used to collect the undisturbed samples for permeability testing as described in Section 3.2.1.4, Geotechnical Sampling.

2.1.1.5 Site SS11-Fuel Spill. Additional site characterization is needed at Site SS11 to evaluate current site conditions and to determine the nature and extent of petroleum hydrocarbon contamination. Site characterization will incorporate the collection of surface and/or shallow subsurface soil samples and geotechnical parameters. Figure 2-6 identifies the proposed soil sample locations. Field activities to be conducted at Site SS11 include the following:

- **Soil Sampling**--Tetra Tech proposes to collect up to five hand-augered soil samples in the vicinity of the former jet fuel spill. Samples will be selected for analysis using field observations and sample screening procedures described in Section 3.2.1.1, Surface and Near-Surface Soil Sampling. The soil samples will be analyzed for diesel-range TPH, VOCs, SVOCs, pesticides and PCBs.

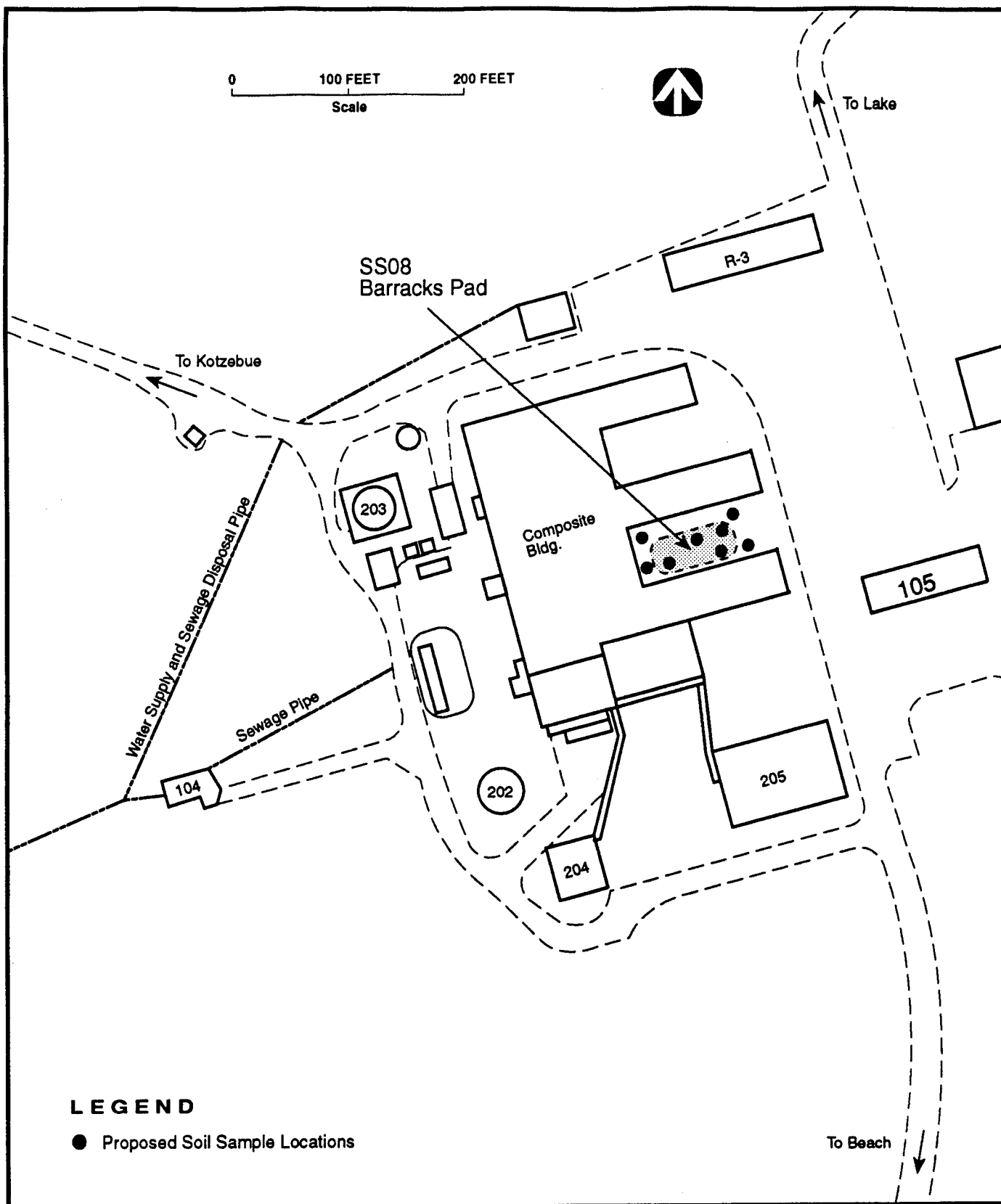


Figure 2-5. Proposed Soil Sample Locations at SS08 Barracks Pad, Kotzebue LRRS, Alaska.

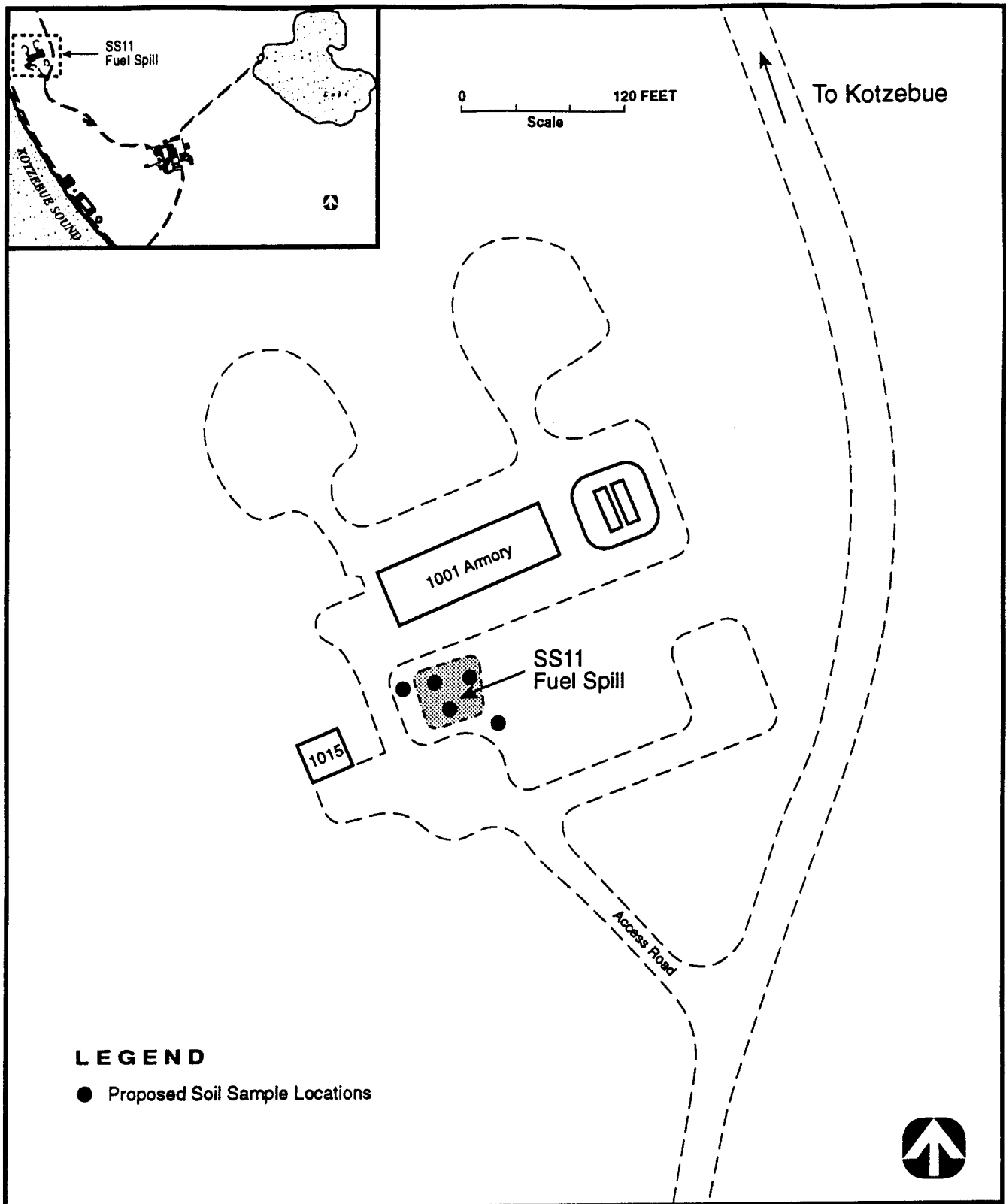


Figure 2-6. Proposed Soil Sample Locations at SS11 Fuel Spill, Kotzebue LRRS, Alaska.

- **Geotechnical Parameters**--Tetra Tech proposes to collect subsoil samples of engineered fill material and native tundra for geotechnical testing to estimate critical parameters regarding contaminant transport in the vicinity of Site SS11. One sample each will be collected from fill material and native tundra and submitted for grain-size analysis (ASTM Methods C136 and D442), soil permeability testing (constant-head, ASTM Method D5084), and analysis of total organic carbon (EPA Method 9060). Sampling will be conducted in areas determined to be free of contamination by the field team. Shelby tubes will be used to collect the undisturbed samples for permeability testing as described in Section 3.2.1.4, Geotechnical Sampling.

2.1.1.6 Site SS12--Spills No. 2 and 3. Previous site investigations have not adequately characterized the vertical and lateral extent of petroleum hydrocarbon contamination at this site. Additional site characterization objectives include the definition of suspected contaminant source areas in gravel fill materials, and characterization of the lateral and vertical extent of contamination. A suite of contaminant and geochemical parameters will be collected from active zone surface waters at Site SS12 in support of an evaluation of natural biodegradation. Figure 2-7 identifies the proposed soil, surface water, and groundwater sample locations. Field activities to be conducted at Site SS12 include the following:

- **Soil Sampling**--Tetra Tech proposes to collect from 30 to 50 near-surface soil samples, with sample locations based on areal coverage and field screening techniques. General site topography slopes moderately to the west toward the Kotzebue Sound, and sample locations will be selected along drainage pathways to evaluate the lateral and downgradient extent of petroleum hydrocarbon contamination in native tundra. Sampling will be conducted using a phased approach. Approximately 30 samples will be submitted for analysis initially, with remaining samples to be collected based on a review of the preliminary sample analytical results. Samples will be selected for analysis using field observations and sample screening procedures described in Section 3.2.1.1, Surface and Near-Surface Soil Sampling. All samples will be analyzed for diesel-range TPH. Ten soil samples will be selected for additional analyses to evaluate individual toxicants, including VOCs, SVOCs, pesticides.

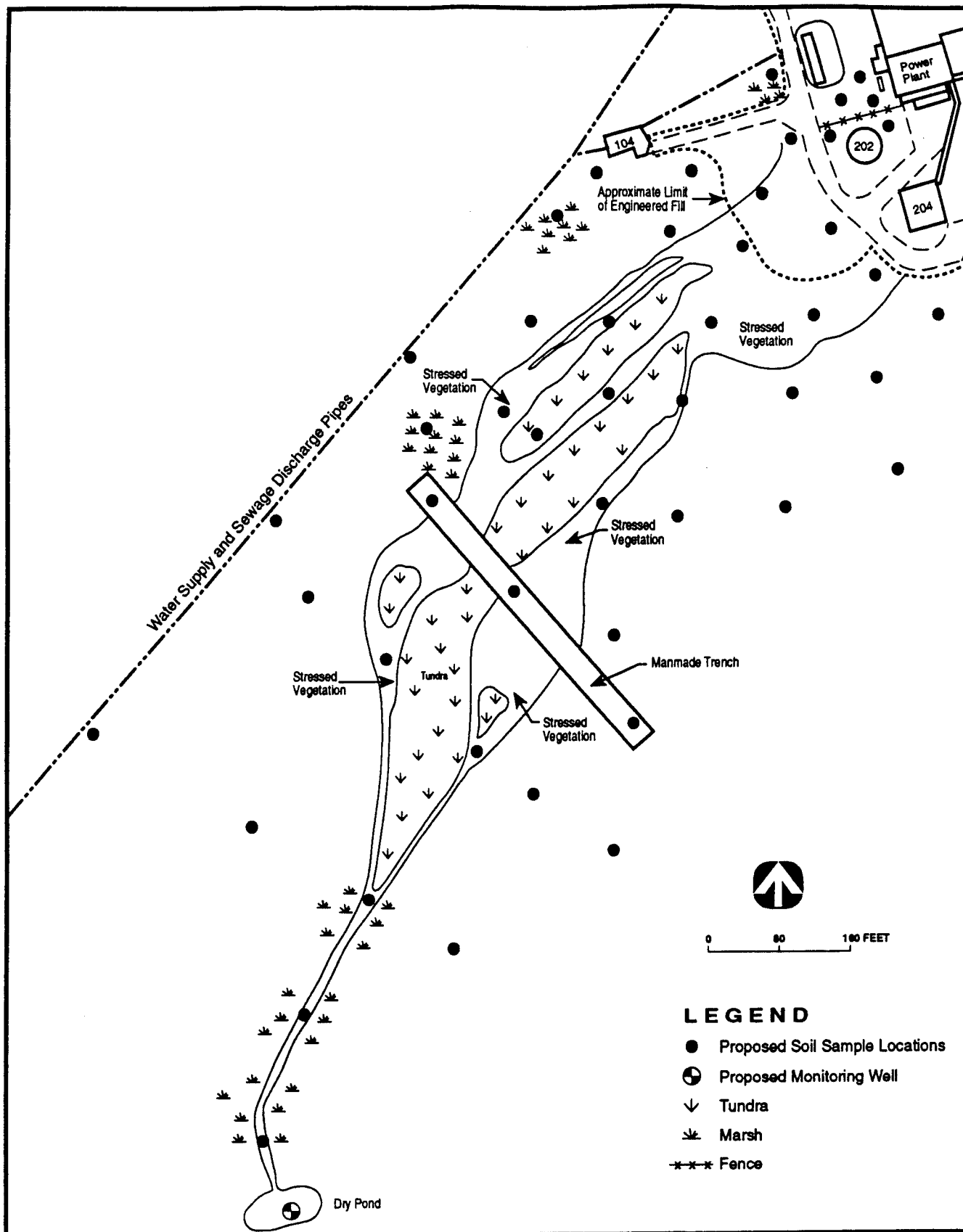


Figure 2-7. Proposed Soil Sample Locations at Site SS12 Spills No. 2 and No. 3, Kotzebue LRRS, Alaska.

- ***Surface Water Sampling***--Three surface water samples will be collected where standing water is present downgradient of contaminant sources (e.g., former cut-off trench). Samples will be selected based on visual observations, such as the presence of an oil sheen, and using field screening techniques. Surface water samples will be analyzed for diesel-range TPH, VOCs, SVOCs, and pesticides. In addition to contaminant chemistry, a suite of geochemical and conventional parameters will be measured in active zone surface waters samples both upgradient and downgradient of the Spills No. 2 and 3 source area. The relationship between surface water geochemistry and contaminant chemistry as surface water moves through this area will allow a determination of the extent to which natural biodegradation may be active, and to what degree natural biodegradation may be responsible for a reduction of contaminant concentrations in surface water. (see Section 3.2.1.6, Surface Water Sampling and Section 3.3.11, Field Test Kits).

- ***Monitoring Well Installation and Groundwater Sampling***--One groundwater sample will be collected from a shallow monitoring well installed at the base of the tundra hill, where site drainage features converge. The groundwater sample will be evaluated to determine if site drainage features provide a pathway for contaminant transport to the near-beach groundwater system, which ultimately discharges into Kotzebue Sound. The groundwater will be analyzed for diesel-range TPH, VOCs, and SVOCs. In addition to contaminant chemistry, near-beach groundwater will also be sampled for geochemical and conventional parameters to support an assessment of natural biodegradation at Site SS12 (see Section 3.1.4, Monitoring Well Installation and Development, Section 3.2.1.7, Groundwater Sampling, and Section 3.3.11, Field Test Kits).

- ***Geotechnical Parameters***--Tetra Tech proposes to collect subsoil samples in engineered fill material and native tundra for geotechnical testing to estimate critical parameters regarding contaminant transport in the vicinity of Site SS12. One sample each will be collected from fill material and native tundra and submitted for grain-size analysis (ASTM Methods C136 and D442), soil permeability testing (constant-head, ASTM Method D5084), and total organic carbon analysis (EPA Method 9060). Sampling will be conducted in areas determined to be free of contamination by the field team. Shelby

tubes will be used to collect undisturbed samples for permeability testing as described in Section 3.2.1.4, Geotechnical Sampling.

2.1.2 Areas of Concern

During the September 1993 site survey, ten areas of concern (AOCs) were identified that warrant further consideration as potential sites during the RI/FS field sampling effort. These AOCs are in addition to the six sites identified during previous IRP remedial investigations at Kotzebue LRRS that are being characterized as part of this remedial investigation (as described in the above section). Figure 2-1 provides an installation diagram identifying the locations of the 10 AOCs. Site investigation activities for identified AOCs are summarized in Table 2-1.

The following section provides a description of field activities and identifies proposed sample locations at the 10 recently identified areas of concern. The proposed locations and numbers of samples to be collected are estimates based on identified data needs and a review of previous IRP investigation site survey results. The proposed site-specific sample locations and numbers of samples collected may vary somewhat based on field conditions encountered during the field investigation.

2.1.2.1 AOC-1 Landfarm. The remedial investigation will include an initial inspection of the landfarm to evaluate the condition of the landfarm cell, characterization of current soil conditions, and an evaluation of the surrounding area to determine the potential extent of contamination if a release(s) from the landfarm is evident. Figure 2-8 identifies the proposed soil sample locations. Field activities to be conducted at AOC-1 include the following:

- ***Landfarm Condition Assessment***--Tetra Tech personnel will evaluate the condition of landfarm containment and examine the ground surface surrounding the landfarm for evidence of seepage or runoff that could indicate that a failure of the landfarm containment berms has occurred, potentially releasing contaminants to the surrounding area. Sample locations will be identified during the assessment based on visual observations and the field screening techniques described in Section 3.1.2, Site Reconnaissance.

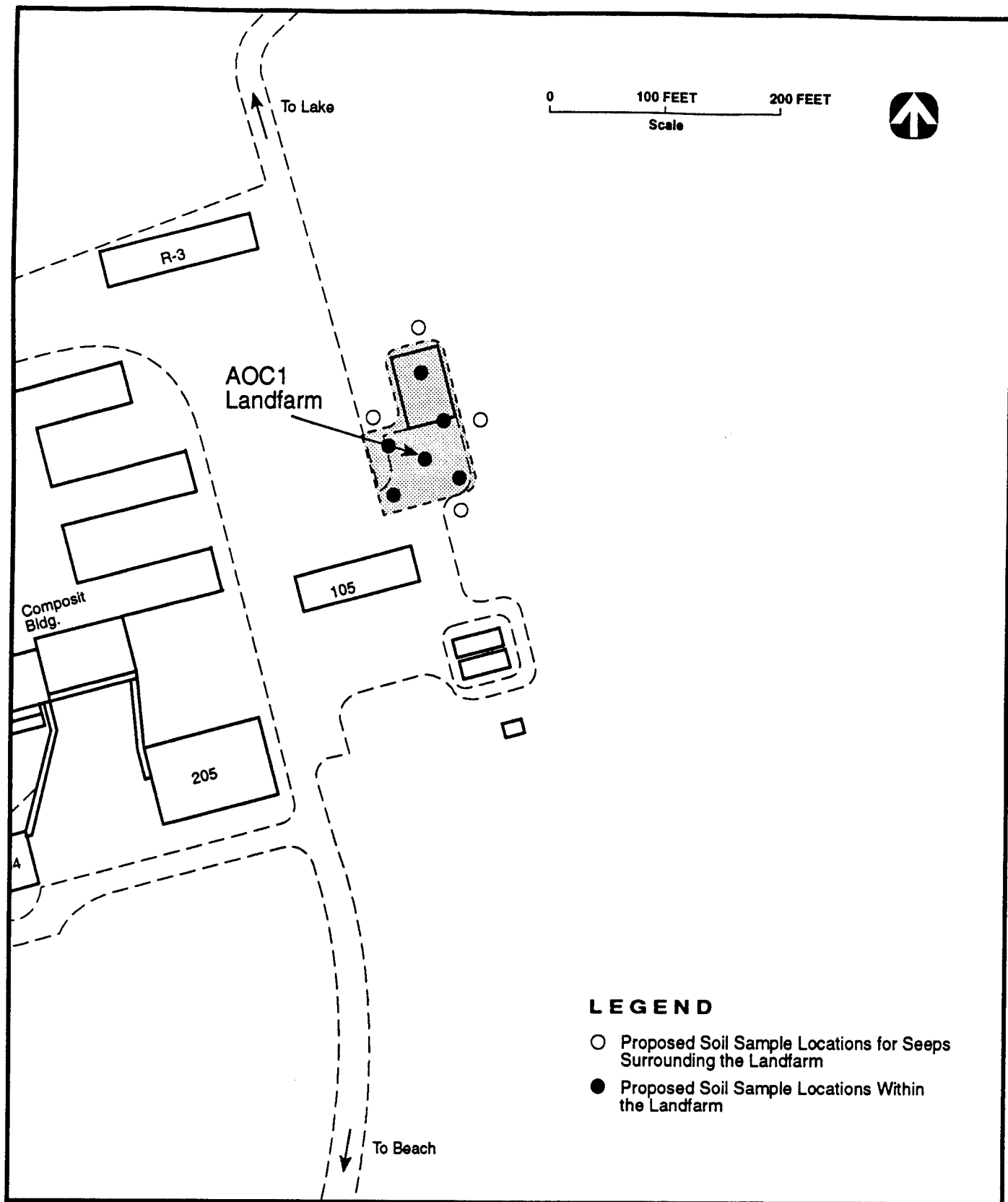


Figure 2-8. Proposed Soil Sample Locations at the AOC1-Landfarm and Surrounding Area, Kotzebue LRRS, Alaska.

- **Landfarm Soil Sampling**--Tetra Tech proposes to collect six soil samples from the existing landfarm to evaluate the current concentrations of compounds known or suspected to be present in landfarm soils. The soil samples will be collected from shallow hand-auger borings at six discrete locations within the landfarm cell. Soil samples collected from each boring will represent a vertical composite of landfarmed material. The maximum thickness of the landfarmed material is estimated to be 2.5 ft. All samples will be analyzed for residual TPH and diesel-range TPH. Three of the six soil samples will be analyzed for the presence of VOCs, SVOCs, pesticides and PCBs, and total metals.

- **Perimeter Soil Sampling**--Tetra Tech proposes to collect four to eight soil samples from locations that exhibit signs of leaching or runoff surrounding the existing landfarm (see Section 3.2.1.1, Surface and Near-Surface Soil Sampling). Soil samples will be analyzed for diesel-range TPH, VOCs, SVOCs, pesticides and PCBs, and total metals.

2.1.2.2 AOC-2 POL Line. The POL Line, a 2-inch pipeline used to transport diesel fuel from the fuel storage tanks to the Composite Facility, runs from the beach tanks area uphill to the main facility. Previous investigations have not included an assessment of the pipeline. Figure 2-9 identifies the proposed soil sample locations. Field activities to be conducted at AOC-2 include the following:

- **POL Line Survey**--Tetra Tech personnel will conduct a visual survey along the entire length of the pipeline to identify holes, loose or disconnected joints and fittings, and any evidence of past leaks. Sample locations will be identified during the survey (see Section 3.1.2, Site Reconnaissance).

- **Soil Sampling**--Tetra Tech proposes to collect from three to eight soil samples from locations along the existing POL Line that exhibit signs of having leaked fuel. If no leaks are apparent, the minimum number of samples (3) will be collected; one from the intake valve near the pumphouse, one from the outlet near the Composite Facility, and one along the pipeline trace at a joint (see Section 3.2.1.1, Surface and Near-Surface Soil Sampling). The soil samples will be analyzed for diesel-range TPH, VOCs, SVOCs, pesticides.

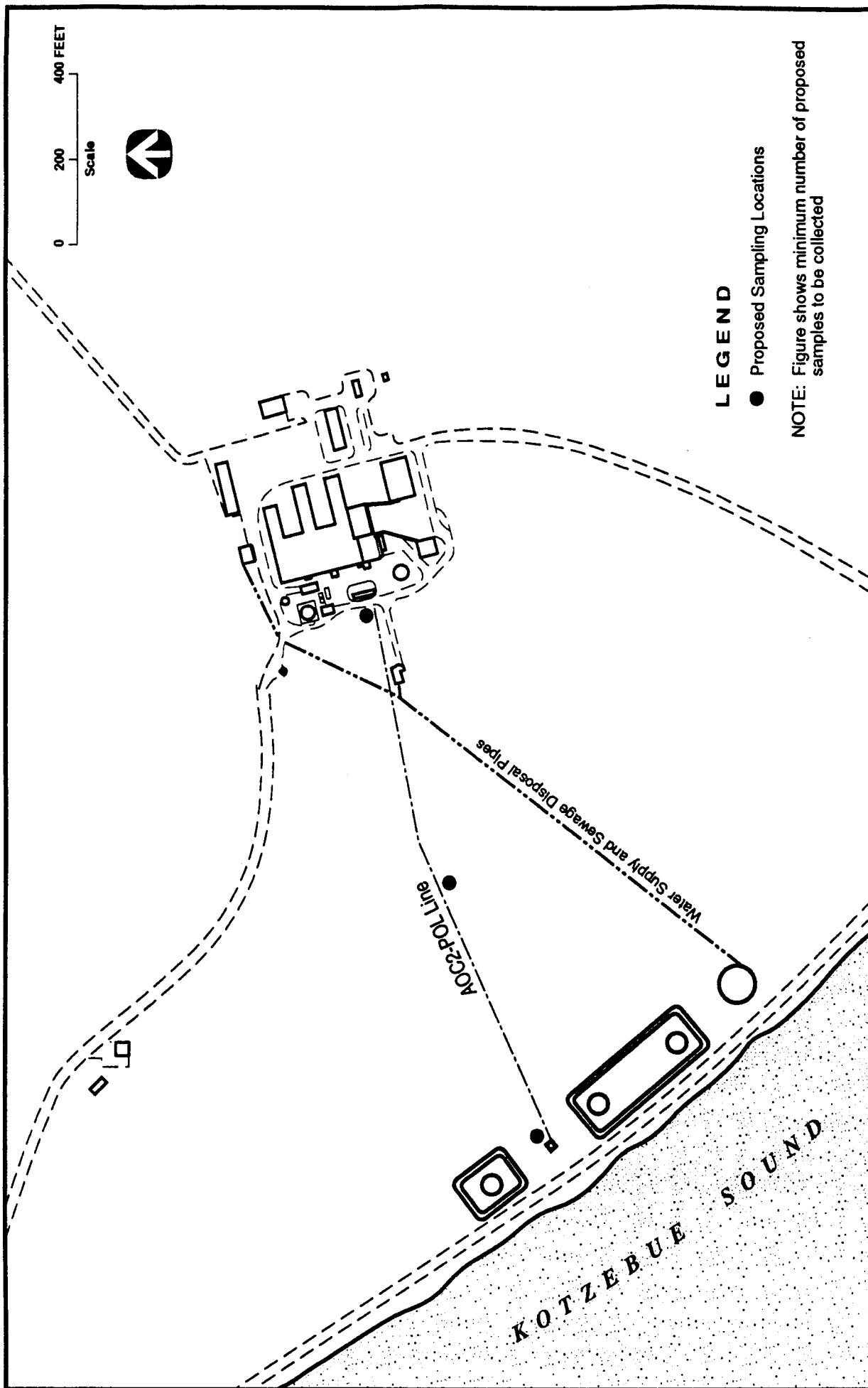


Figure 2-9. Proposed Soil Sample Locations Along the AOC2-POL Lines, Kotzebue LRRS, Alaska.

2.1.2.3 AOC-3 East Tanks. Two empty above-ground diesel fuel storage tanks (estimated capacity = 20,000 gal each) are located on the east side of the access road adjacent to Building 205. The tanks and surrounding area have not been assessed previously. Some limited soil staining directly beneath tank outlet valves was observed during the September 1993 site survey. Figure 2-10 identifies the proposed soil sample locations. Field activities to be conducted at AOC-3 include:

- **Soil Sampling**--Tetra Tech proposes to collect from three to six soil samples from locations under and/or surrounding the existing above-ground fuel tanks. These samples will be collected at locations that exhibit evidence of leaked fuel based on field screening techniques (see Section 3.2.1.1, Surface and Near-Surface Soil Sampling). The soil samples will be analyzed for diesel-range TPH, VOCs, SVOCs, and pesticides.

2.1.2.4 AOC-4 Garage/Power Plant. Stained soils were observed during the September 1993 site survey both beneath the raised flooring of the power plant and in the garage area associated with the Composite Facility. The garage was the vehicle maintenance center for the facility, and past waste disposal practices associated with the garage area are not known. No previous characterization of soils beneath these facilities has been conducted, and characterization will incorporate analyses for a variety of compounds. Figure 2-11 identifies the proposed soil sample locations. Field activities to be conducted at AOC-4 include the following:

- **Garage/Power Plant Inspection**--Tetra Tech personnel will inspect the interior of the power plant and garage structures to identify past operations potentially involving the use of hazardous materials. The inspection will also locate any floor drains that could provide a pathway for hazardous substances to impact soils beneath the structures (see Section 3.1.2, Site Reconnaissance).
- **Soil Sampling**--Tetra Tech proposes to collect between four and eight soil sample locations beneath the garage/power plant area that exhibit evidence of contamination. Sample locations will be determined using field screening techniques, and will include areas beneath drain outlets, if encountered (see Section 3.2.1.1, Surface and Near-Surface Soil Sampling). Soil samples will be analyzed for residual TPH, gasoline-range and diesel-range TPH, VOCs, SVOCs, pesticides and PCBs, and total metals.

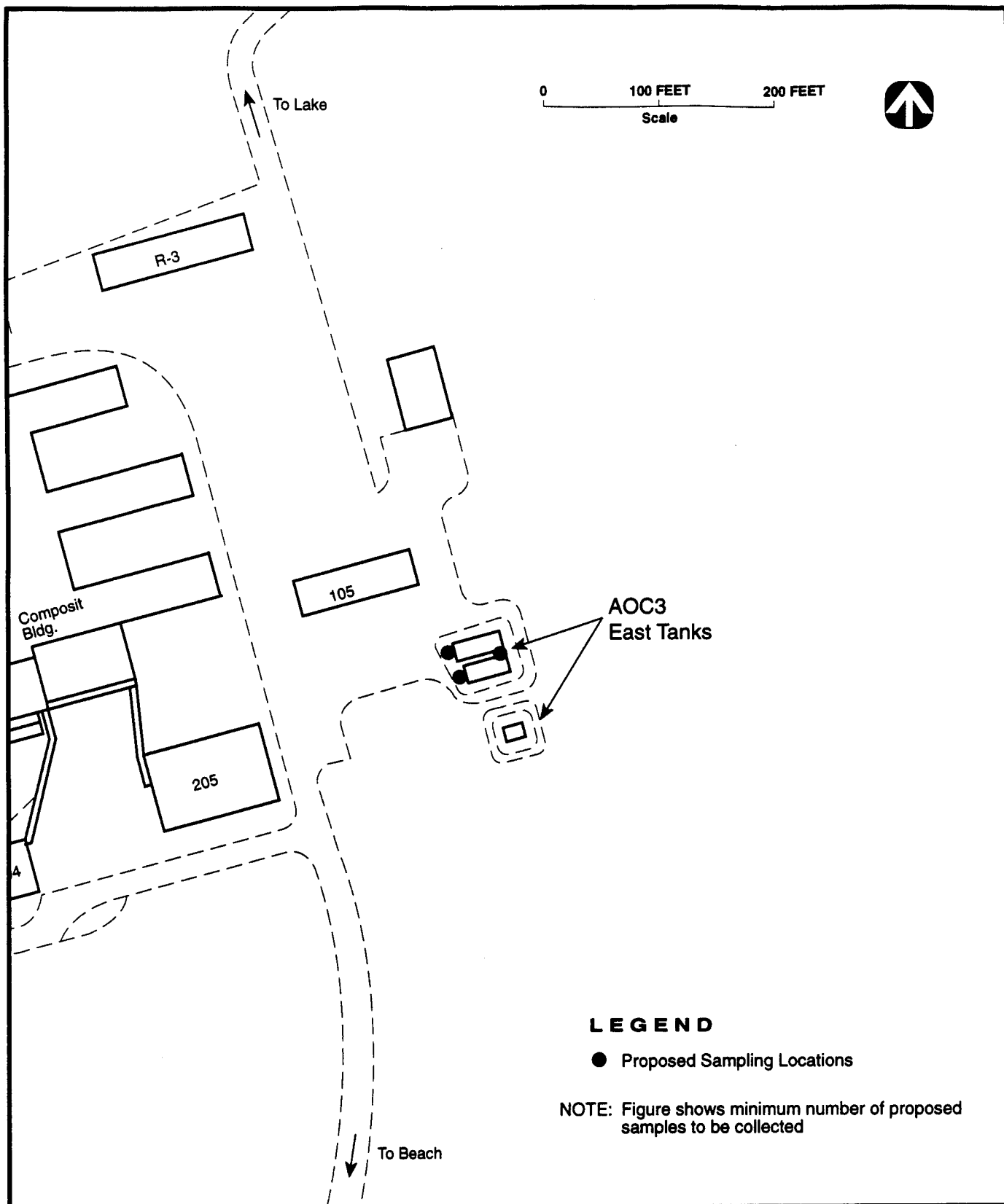


Figure 2-10. Proposed Soil Sample Locations in Vicinity of AOC3-East Tanks, Kotzebue LRRS, Alaska.

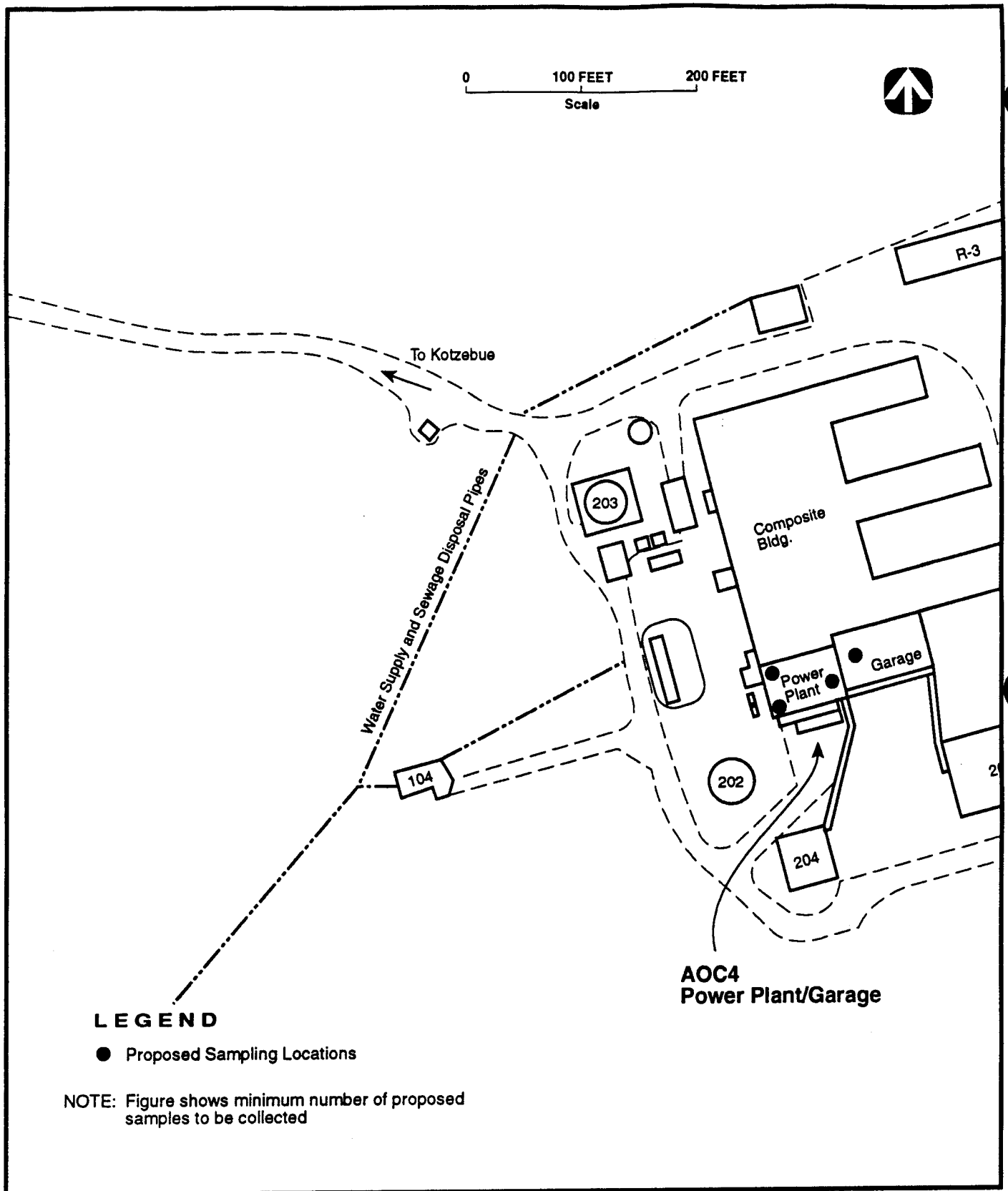


Figure 2-11. Proposed Soil Sample Locations at AOC4-Power Plant/Garage, Kotzebue LRRS, Alaska.

2.1.2.5 AOC-5 Small Day-Tanks. A number of small day-tanks were formerly used throughout the installation for heating and equipment operation. Approximately 12 to 15 250-gal aboveground diesel fuel tanks are present at the facility. Diesel fuel releases could have occurred historically due to overfilling or by direct release from tanks or tank lines. No previous assessment of the day-tanks as a group has been conducted. Field activities to be conducted at AOC-5 include:

- **Soil Sampling**--Tetra Tech proposes to collect up to 20 soil samples under and/or surrounding day tanks at various locations at the facility. The samples will be collected at locations that exhibit evidence of leaked fuel based on visual observations and field screening techniques. A minimum of one sample will be collected at each tank location; more samples will be collected if significant contamination is directly observed (see Section 3.2.1.1, Surface and Near-Surface Soil Sampling). The samples will be analyzed for diesel-range TPH, VOCs, SVOCs, and pesticides.

2.1.2.6 AOC-6 Navigational Aid Buildings (101 and 200). The navigational aid building and an adjacent structure have been included for assessment based on elevated TPH concentrations in soils identified during a 1993 Environmental Site Assessment conducted at Building 101. Assessment will include a building inspection and a survey of the surrounding area. Figure 2-12 identifies the proposed soil sample locations. Field activities to be conducted at AOC-6 include the following:

- **Building Inspection**--Tetra Tech personnel will inspect structure interiors for indications of past operations involving the potential use or storage of hazardous materials. Floor drains and plumbing outlets will be identified to allow an evaluation of potential discharge locations (see Section 3.1.2, Site Reconnaissance).
- **Soil Sampling**--Tetra Tech proposes to collect from three to six soil samples from locations surrounding the navigational aid building that exhibit evidence of contamination based on visual observations and field screening results (see Section 3.2.1.1, Surface and Near-Surface Soil Sampling). The samples will be analyzed for diesel-range TPH, VOCs, SVOCs, pesticides and PCBs, and total metals.

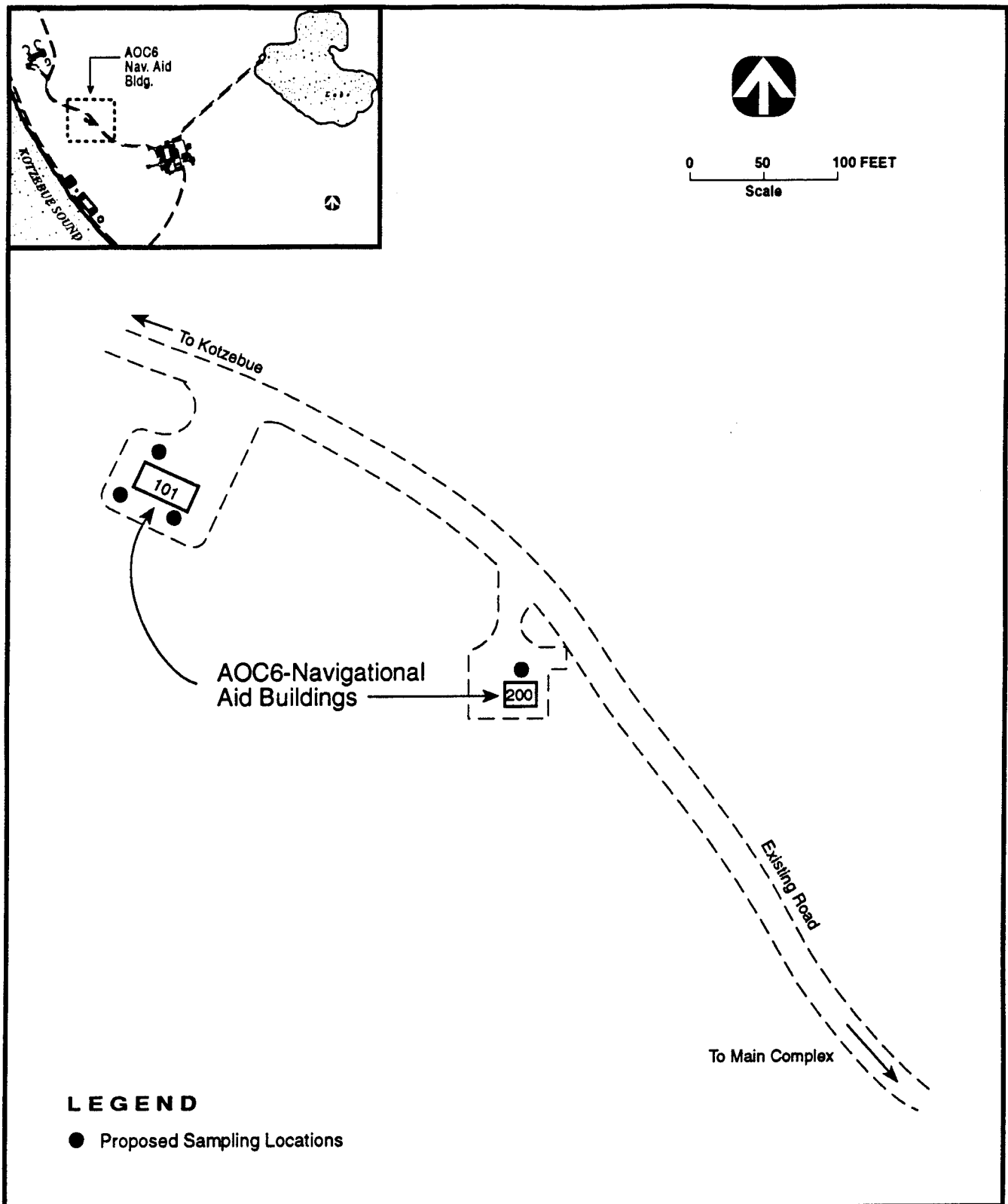


Figure 2-12. Location of Existing Structures at the AOC6-Navigational Aid Building, Kotzebue LRRS, Alaska.

2.1.2.7 AOC-7 Steel Pilings. Steel pilings were discovered southeast of the Composite Facility during the September 1993 site survey. Buildings identified during a review of historical aerial photographs suggest that this was a former construction camp established during the construction of the radar facility. Site characterization will include a visual inspection of the area and limited soil sampling based on field screening results (see Section 3.1.2, Site Reconnaissance). Figure 2-13 identifies proposed soil sample locations. Field activities to be conducted at AOC-7 include:

- **Soil Sampling**--Tetra Tech proposes to collect from three to six soil samples at locations surrounding the steel pilings based on visual observations and field screening results (see Section 3.2.1.1, Surface and Near-Surface Soil Sampling). All samples will be analyzed for diesel-range TPH, VOCs, SVOCs, pesticides and PCBs, and total metals.

2.1.2.8 AOC-8 White Alice Garage. The White Alice Garage was reportedly used for storing and servicing site vehicles, and has been recommended for assessment based on its operational history. The assessment will include an inspection of the garage facility and surrounding area. Limited soil sampling will be conducted based on visual observations and field screening results. Figure 2-14 identifies proposed soil sample locations. Field activities to be conducted at AOC-8 include the following:

- **White Alice Garage Inspection**--Tetra Tech personnel will inspect the garage interior for indications of past operations involving the potential use or storage of hazardous substances. Floor drains and plumbing outlets will be identified to allow an evaluation of potential discharge locations. The area surrounding the garage will be also be inspected for evidence of contamination (see Section 3.1.2, Site Reconnaissance)
- **Soil Sampling**--Tetra Tech proposes to collect between three and six soil samples from locations in the garage and surrounding area that exhibit signs of contamination based on visual observations and field screening results (see Section 3.2.1.1, Surface and Near-Surface Soil Sampling). The soil samples will be analyzed for residual TPH, gasoline- and diesel-range TPH, VOCs, SVOCs, pesticides and PCBs, and total metals.

2.1.2.9 AOC-9 White Alice Tanks. Two empty above-ground diesel fuel storage tanks with an estimated capacity of 20,000 gal each are located adjacent to Building 1001 at the White Alice Station. The tanks

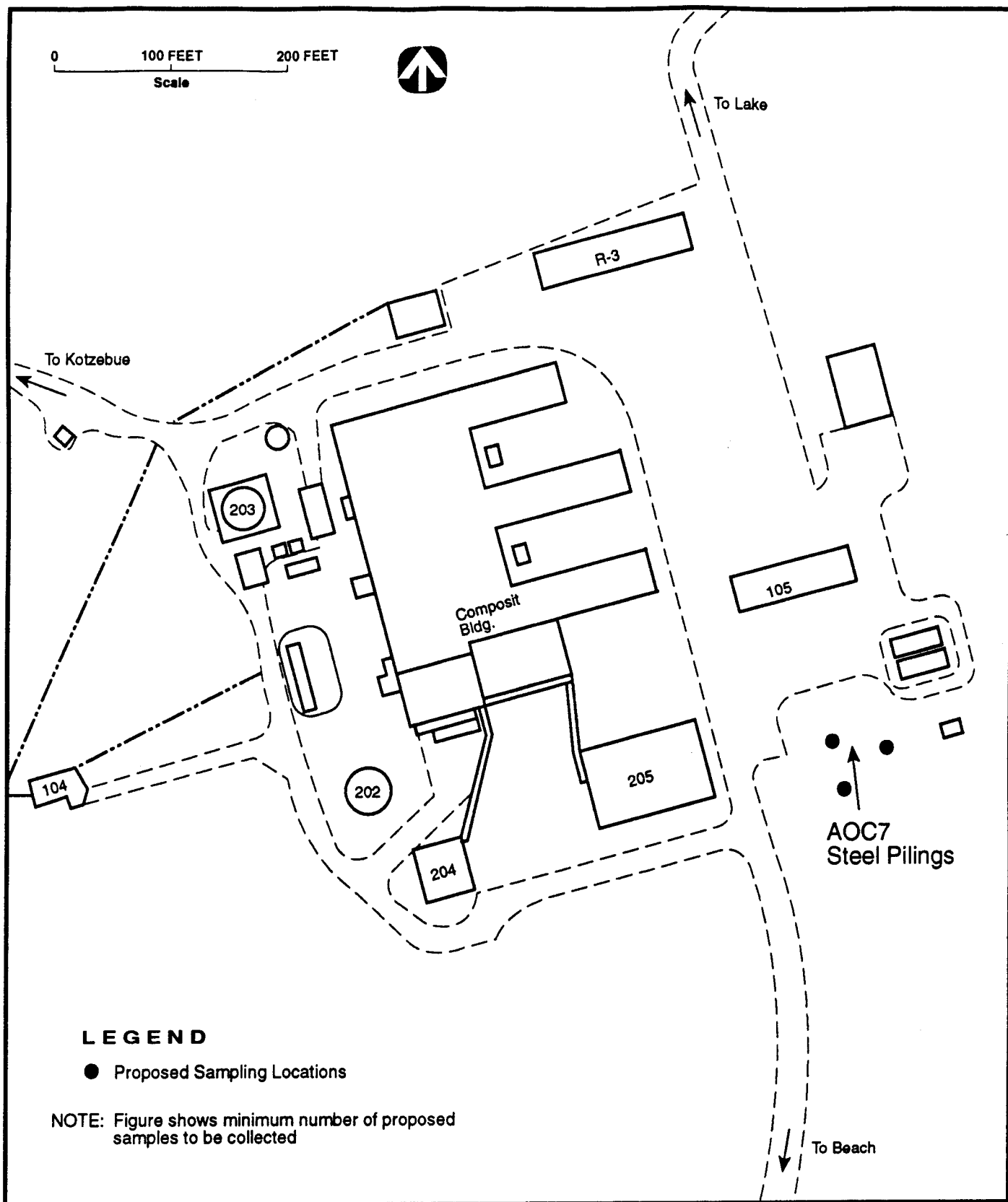


Figure 2-13. Proposed Soil Sample Locations at AOC7-Steel Pilings, Kotzebue LRRS, Alaska.

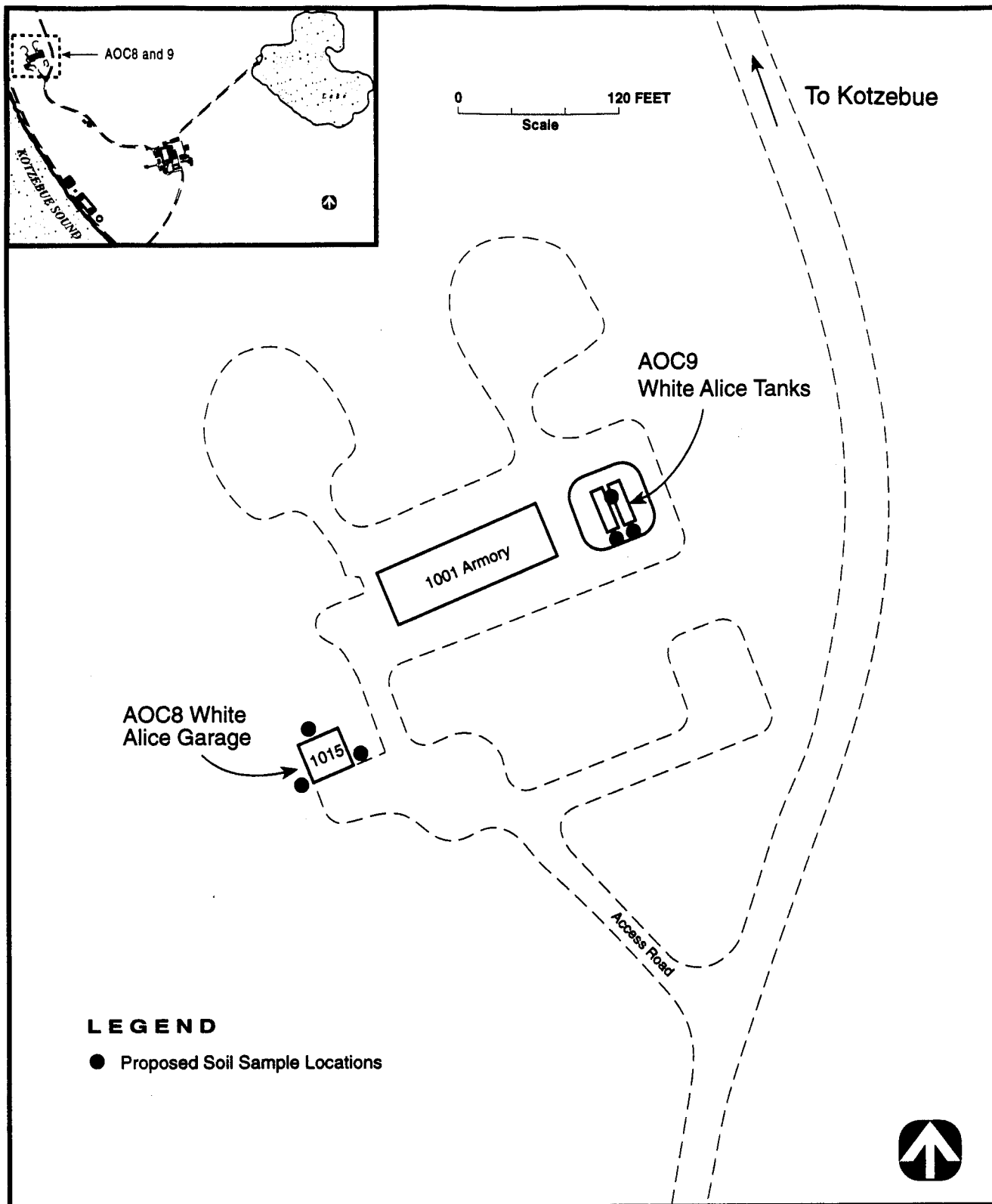


Figure 2-14. Proposed Soil Sample Locations at AOC8-White Alice Garage and AOC9-White Alice Tanks, Kotzebue LRRS, Alaska.

and surrounding area have not been previously assessed. Limited soil staining was observed directly beneath tank outlet valves during the September 1993 site survey. Figure 2-14 identifies the proposed soil sample locations. Field activities to be conducted at AOC-9 include:

- **Soil Sampling**--Tetra Tech proposes to collect from three to six soil samples at locations under and/or surrounding the above-ground fuel tanks. The samples will be collected at locations that exhibit signs of leaked fuel based on visual observations and field screening results (see Section 3.2.1.1, Surface and Near-Surface Soil Sampling). The samples will be analyzed for diesel-range TPH, VOCs, SVOCs, and pesticides.

2.1.2.10 AOC-10 Septic Holding Tank. Primary treatment of domestic sewage and wastewater at Kotzebue LRRS was provided by a single septic tank located west of the Composite Facility. Septic tank effluent was discharged into Kotzebue Sound via an outfall line. Figure 2-15 identifies the proposed soil sample locations. Field activities to be conducted at AOC-10 include:

- **Sludge and Soil Sampling**--Tetra Tech proposes to collect one sludge sample from the facility septic tank to evaluate the characteristics of discharges to the former wastewater and sewage treatment system (see Section 3.2.1.3, Sludge Sampling). If preliminary analytical results indicate the presence of contamination by hazardous materials, an assessment of the existing sewer line will be conducted. One to three soil samples will be collected at locations exhibiting evidence of leaks or other modes of contamination (see Section 3.2.1.1, Surface and Near-Surface Soil Sampling). The samples will be analyzed for diesel-range TPH, VOCs, SVOCs, pesticides and PCBs, and total metals.

2.1.3 Background Characterization

Previous RI/FS field investigation activities at Kotzebue LRRS did not include the collection and analysis of background samples from the various media sampled in study areas during the RI. The concentration of contaminants in background samples will provide the baseline concentration data necessary to evaluate site-specific samples collected from each media and source area during the proposed field sampling. Such evaluations are used to delineate source areas, recommend remedial actions, and evaluate media-specific concentrations relative to ARARs for the individual sites and areas of concern. Permission to collect background samples at locations outside the facility boundary will be obtained from property owners prior

LEGEND

● Proposed Sampling Locations

0 100 FEET 200 FEET
Scale

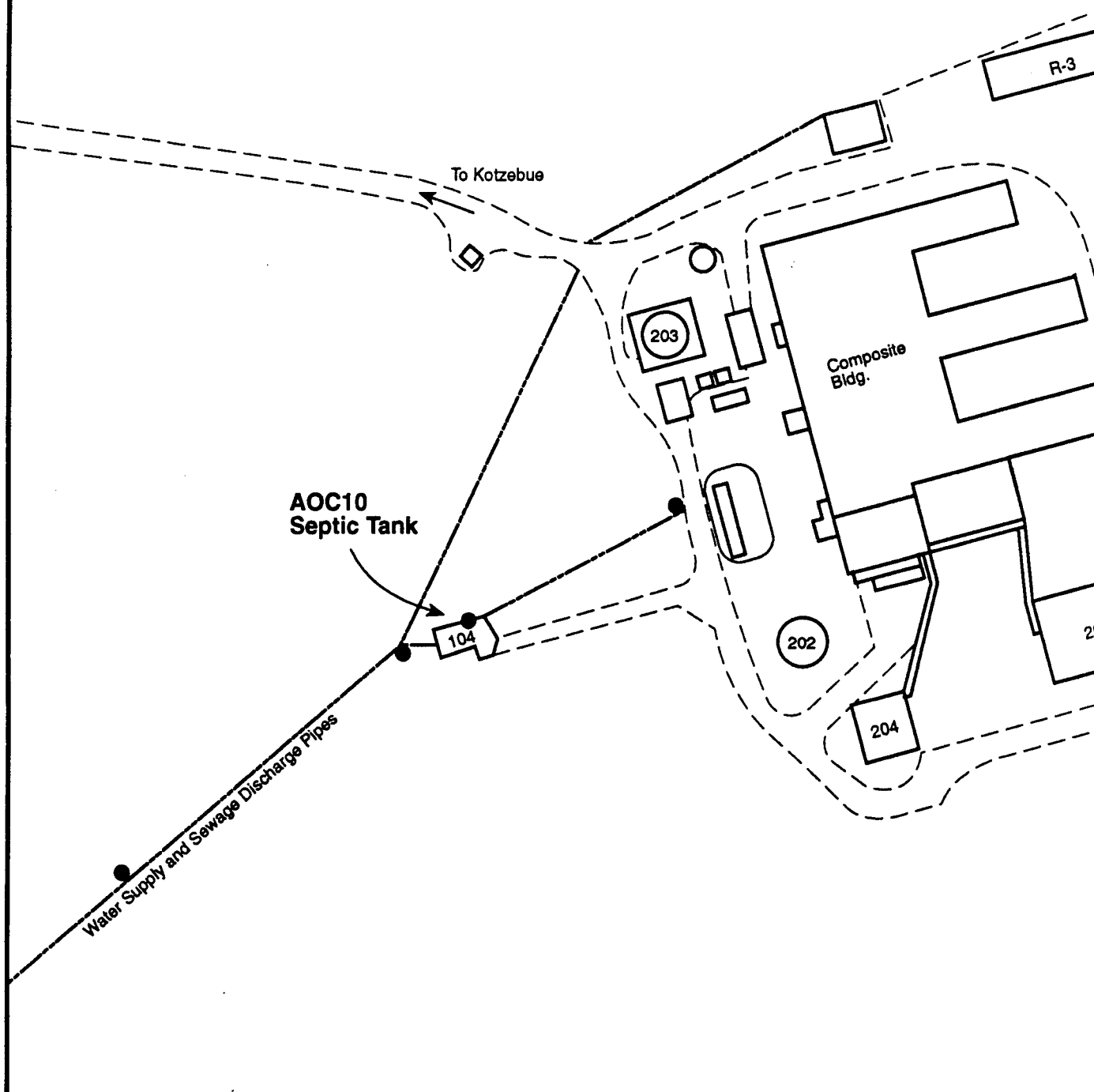


Figure 2-15. Proposed Soil Sample Locations at AOC10-Septic Holding Tank, Kotzebue LRRS, Alaska.

to beginning field work at these locations. Background characterization will include all analyses performed and media sampled during the remedial investigation. Figure 2-16 identifies the proposed background sample locations. Background characterization will include the following:

- ***Soil Sampling***--Tetra Tech proposes to collect three soil samples to evaluate background conditions in native tundra in the vicinity of the site. All background soil samples will be analyzed for residual TPH, gasoline- and diesel-range TPH, VOCs, SVOCs, pesticides and PCBs, and total metals.
- ***Sediment Sampling***--Tetra Tech proposes to collect six sediment samples to evaluate background conditions, including three lake sediment samples and three beach sediment samples. All background sediment samples will be analyzed for the presence of residual TPH, diesel-range TPH, VOCs, SVOCs, pesticides and PCBs, and total metals.
- ***Groundwater Sampling***--One background groundwater monitoring well will be installed north of Site SS02 in an area with no known or suspected upgradient source of contamination. One groundwater sample will be collected from this well to evaluate background groundwater conditions. In addition, three groundwater monitoring wells will be installed at Site SS02 to evaluate groundwater quality. Some or all of these three wells may potentially serve as monitoring points for groundwater that is unaffected by waste disposal activities or spills at the site. All of the background groundwater samples will be analyzed for a broad spectrum of contaminants, including diesel-range TPH, VOCs, SVOCs, pesticides and PCBs, and both total and dissolved metals. Four upgradient groundwater monitoring wells will be installed and sampled at Site ST05, Beach Tanks; these samples will be analyzed for a more limited suite of contaminants, including diesel-range TPH, VOCs, SVOCs, and geochemical and conventional parameters. These wells will provide upgradient groundwater quality samples for Site ST05, and may potentially be used to augment the background groundwater samples discussed above if these wells are unaffected by distal upgradient source areas.

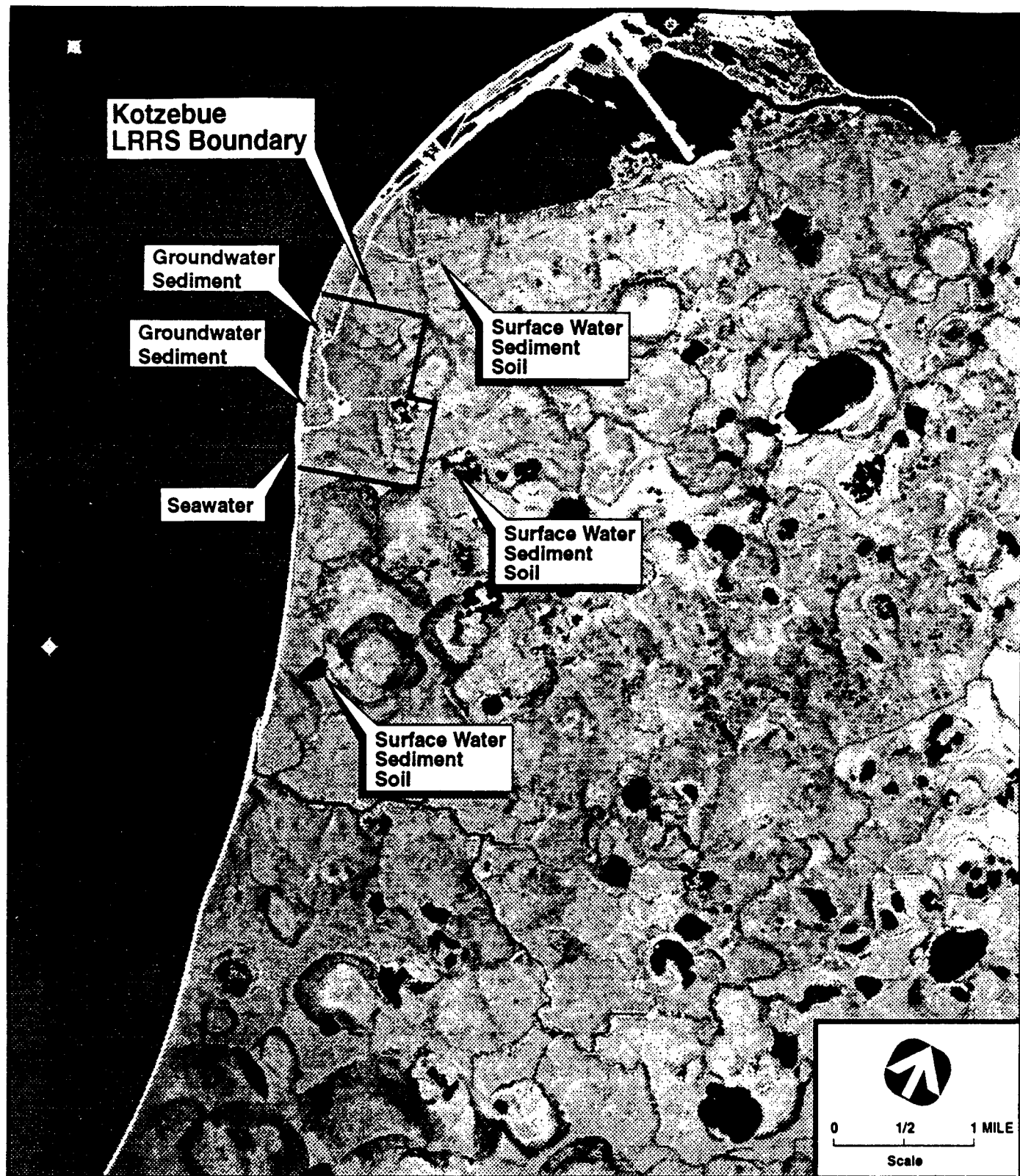


Figure 2-16 Proposed Background Sample Locations, Kotzebue LRRS, Alaska.

- *Surface Water Sampling*--Tetra Tech proposes to collect three surface water samples to evaluate background concentrations in the vicinity of the site. The background surface water samples will be analyzed for diesel-range TPH, VOCs, SVOCs , pesticides and PCBs, and both total and dissolved metals. A suite of geochemical parameters will be collected at one of the three freshwater background locations to provide background concentrations for conventional and other parameters for surface water in an area unaffected by petroleum hydrocarbons. These data will be used to evaluate the geochemical sample analytical results for surface water samples collected at Site SS12-Spills No. 2 and 3 in support of an evaluation of natural biodegradation.

- *Seawater Sampling*--Tetra Tech proposes to collect one seawater sample to evaluate background conditions in Kotzebue Sound. The background seawater sample will be analyzed for diesel-range TPH, VOCs, and SVOCs.

3.0 FIELD INVESTIGATION PROCEDURES

The following section details the standard operating procedures (SOPs) to be implemented in conducting the RI/FS field sampling at Kotzebue LRRS. These procedures were developed by Tetra Tech to provide a consistent format for conducting reliable field investigations, and to ensure that field effort tasks are completed in an accurate, cost-effective, and reproducible manner. The SOPs also provide the necessary framework for developing contingency plans to avoid delays in the field due to equipment problems or site-specific considerations that may arise once the field effort has been initiated. Unless specified, the field investigation activities described in this section conform to the guidelines established by the *IRP Handbook*.

3.1 FIELD OPERATIONS

The following section details the field operating procedures to be implemented in conducting the site investigation at Kotzebue LRRS. This section details field activity meetings, site reconnaissance lithologic descriptions, monitoring well installation and development, gradiometric survey, aquifer testing, tidal monitoring, surveying, decontamination procedures, and investigation derived waste management for the Kotzebue LRRS RI/FS effort.

3.1.1 Daily Field Activities Meeting

A daily field activities meeting will be conducted by the Field Operations Manager and Site Safety Officer prior to commencement of work. During this meeting, all project personnel (including subcontractors) will review project plans and discuss proposed field activities and special job requirements. Additionally, a safety meeting will be conducted with all involved personnel. The designated Safety Officer will make sure that all individuals are aware of potential hazards.

3.1.2 Site Reconnaissance

Site reconnaissance will be routinely conducted to identify the current use and condition of surface structures and other features previously identified in reports, facility maps, and photographs. Site Reconnaissance will allow the identification and mapping of changes in site conditions that may have occurred since the most recent maps or photographs were made, and it makes possible the mapping of small but significant features that may not be visible on existing maps or photographs (e.g., the locations of all day tanks). Site reconnaissance is an important means of identifying areas of possible contamination from suspect stained ground or other evidence of past site usage that is indicative of potential contaminant releases. Preparation for site reconnaissance includes the following steps:

1. Review available maps, photographs, and records to gather information about the history and usage of the site. Identify features in maps and photographs that seem to warrant a physical inspection. In general, identify features of concern before entering the site.
2. Identify from the available information what type of hazards to expect at the site and the contaminants that may be present. Determine the level of personal protective equipment and type of monitoring instruments that are needed. Make sure that field screening equipment is properly calibrated and in working order before entering the site (see Section 3.4, Instrument Calibration and Maintenance).
3. Plan the reconnaissance. Make a list of structures and features to be examined before actually going to the site. This will help to avoid overlooking important features.
4. Site access authorization will be obtained from USAF prior to conducting site Reconnaissance activities.

Site Reconnaissance will include methodically walking the site, following the site reconnaissance plan and checking off the items on the list as they are inspected. Field screening will be conducted as necessary, with results recorded in the field logbook. Uses of buildings and structures that may be associated with contaminant sources will be described in the field logbook and identified on the base map. The location of all day tanks will be identified on the base map, with a description of their condition, including signs of corrosion, leakage or spillage noted in the field logbook. Areas of stained soil and/or distressed

vegetation will be identified, described and clearly marked for investigation. All descriptions and field notes will be legible, concise, and clear so that another person can read and interpret them later. Measurements from prominent structures (buildings, fences, etc.) will be used to locate noted features so that they can be plotted accurately.

3.1.2.1 Field Screening. Field screening will be conducted during site reconnaissance to identify contaminant sources in soils and sediments, to verify the presence of contamination at a location without submitting samples to an analytical laboratory, and to monitor the concentration of airborne volatile organic compounds to establish appropriate worker safety procedures and to support later sampling. Field screening will be performed during site Reconnaissance by visual observations, conducting air monitoring using a PID, and material testing using field test kits.

Visual observations will identify areas of obvious contamination in surface soils and water, or in subsoils and groundwater extracted from the subsurface. Direct visual observation of contamination in surface soil and water will guide the collection of surface samples, the location of soil borings, and more detailed screening using a PID or field test kits. All visually observed surface contamination shall be documented on the observer's daily logbook, and located on the project basemaps.

Screening Using a PID

During site reconnaissance, a PID will be used to identify surface soils and structures with elevated concentrations of ionizable organic vapors. Elevated readings will identify the specific areas to be considered for sampling at sites and areas of concern. During sampling activities, a PID will also be used to screen samples and prioritize those selected for laboratory analysis.

All sample material will be screened for the presence of contaminants using a photoionization detector (PID; e.g., HNu or equivalent). Field screening will be conducted during the collection of surface soil samples, near-surface soil sampling using a hand-auger, and the collection of subsoil samples during drilling. Field screening activities will be performed according to the guidelines described below.

- For surface soil samples and hand-augered soil samples: a wide-mouth glass jar will be filled approximately halfway with recovered sample material. The mouth of the jar will be covered with aluminum foil.
- The covered jar will then be set aside for a brief period (approximately 5 minutes) in a warm area, if available.
- After 5 minutes, the tip of the PID will be pushed through the aluminum foil and the level of total ionizable compounds in the head space of the jar will be read from the PID and recorded in the daily field logbook.
- For subsoil samples collected during drilling: the tip of the PID will be inserted between adjacent brass sample liners in the split spoon sampler immediately upon retrieval of the sampler from the borehole. The PID response will be recorded on the boring log.

Material Testing Using Field Test Kits

Field screening of soil samples for the presence of TPH and PCBs will be performed using field test kits, where appropriate (e.g., areas of stained soil or visible sheen on surface water). Samples will be screened for the presence of TPH using a commercially available petroleum hydrocarbon test kit. PCB screening will be performed using Dexsil CLOR-N-SOIL® field test kits. All sample screening will be performed following instructions supplied with the kits by the manufacturer. All field screening results will be recorded in the field logbook, and will assist in the identification of sample locations at individual sites and areas of concern.

3.1.2.2 Building Inspections. Building inspections will be performed at the start of the field season and will involve the inspection of existing site structures for indications of past activities that may have resulted in the release of contaminants to the environment. Particular attention will be paid to floor drains, stained soils, sewer lines and other piping, and indications of past hazardous substance use or storage.

Building access authorization will be obtained from the USAF prior to conducting building inspections. Building inspections will be conducted in accordance with protocols established in the companion Health and Safety Plan. Equipment needed to conduct building inspections include detailed building base maps, assorted tools (e.g., flashlights and tape measures), air monitoring equipment (e.g., explosimeter and PID), camera, the field logbook, and building access keys. Procedures to conduct building inspections include the following steps:

1. Select a reference point within the structure that all measurements will be made from (i.e. the southeast corner of the building).
2. Identify all floor drains, sewer pipes, and areas of obvious contamination on the building site plan, measuring and recording their location relative to the reference point.
3. Examine the ground surface surrounding and under the building (if accessible) for stained soils or other indications of past leaks. Note these locations on the building site plan, measuring and recording their location relative to the reference point and potential sources such as floor drains, piping, etc.
4. Examine all drain piping under the buildings for evidence of leaks and mark locations on the site plan, measuring their locations relative to the reference point. Record all observations in the field logbook.

3.1.3 Lithologic Description and Logging

Lithologic descriptions of unconsolidated soils will include grain size, color, texture, moisture content (e.g., dry to saturated), stiffness or density, and descriptive comments (e.g., evidence of odor or staining). Unconsolidated soils will be classified according to the Uniform Soil Classification System (USCS) and ASTM D-2487-85 using the Visual-Manual Procedure detailed in ASTM D-2488-84. Soil colors will be classified and noted using a Munsell Soil Color Chart. Lithologic description procedures and protocols are detailed in Appendix A.

A complete log of conditions encountered during drilling will be maintained by a registered geologist providing drilling oversight. Boring logs will be continuously maintained throughout drilling operation

and will include the geologist's name, project name and number, name of the drilling contractor, the drilling method employed, the precise location of the boring measured relative to site structures and noted on a site base map, the boring or well identification number, the sample standard penetration blow counts, sample intervals and depths, the sample recovery (inches recovered/inches driven), variations in drilling rates and rig behavior, lithologic description (see above), PID headspace readings, depth to the first encountered water, and total depth of the borehole. Each boring log will be signed at the bottom by the geologist logging the boring. A vertical cross-section of the borehole, showing annular fill materials for soil boring abandonments and well construction details for completed monitoring wells, will be completed by the geologist logging the boring. Examples of boring logs and well completion forms are presented in Appendix B. Figure 3-1 identifies a general well construction diagram for Kotzebue LRRS.

3.1.4 Monitoring Well Installation and Development

The purpose of installing groundwater monitoring wells is to facilitate an evaluation of groundwater quality and potentiometric levels. To meet these objectives, standard protocols will be followed during well installation and development, lithologic logging, water level measurements, and sampling.

The construction of monitoring wells for the Kotzebue LRRS RI/FS will vary slightly from the guidelines established for monitoring well construction in the *IRP Handbook*. The *IRP Handbook* requires that all applicable state and local regulations regarding drilling, abandonment, and well construction be complied with. This portion of the Field Sampling Plan is designed to adhere to all applicable State of Alaska regulations, as no local regulations have been identified. The proposed variations are based on the completion of monitoring wells in remote locations and areas of shallow permafrost and groundwater, and are limited to necessary variations in borehole diameter and the thickness of annular fill materials.

3.1.4.1 Well Installation. The borings in which monitoring wells will be installed will be drilled using a track-mounted hollow-stem auger drill rig equipped with 4.25-inch i.d. hollow-stem augers. Borings will be advanced using standard drill-and-drive techniques. Standard penetration test data will be recorded for each sample drive in blows per 6 in. A registered geologist will supervise all drilling and well installations, and will prepare lithologic logs of borings using the USCS as described in Section 3.1.3, Lithologic Description and Logging. Where appropriate, soil samples will be collected as described in Section 3.2.1.2, Subsoil Sampling.

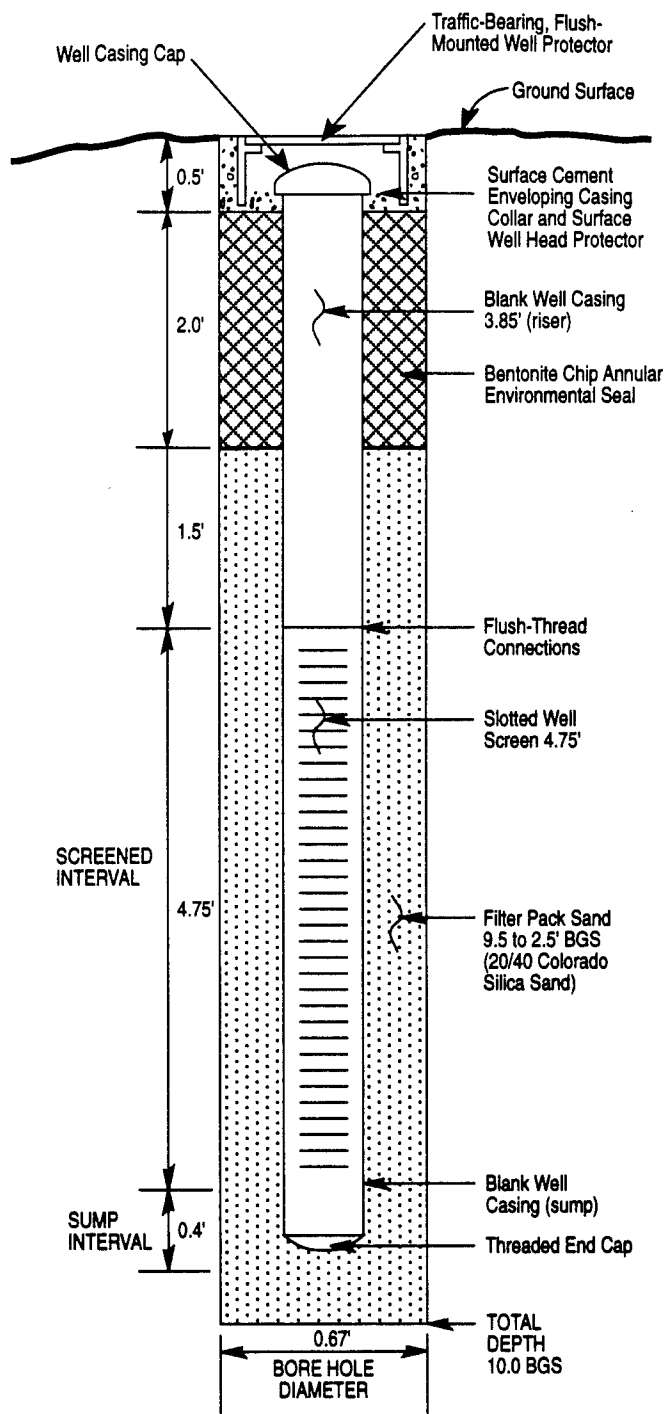


Figure 3-1. Construction Diagram for Typical Groundwater Monitoring Well, Kotzebue LRRS, Alaska.

All required drilling permits will be obtained prior to the commencement of drilling. The signed permits (or copies thereof) will be kept at the site during drilling. Because of the presence of permafrost at Kotzebue LRRS, all utilities are above-ground structures. Therefore, underground clearances and/or utility locations will not be required. Drilling will be conducted at least 20 feet from overhead electrical lines. If contact is made with any manmade underground structure, drilling will immediately stop and the borehole will be abandoned according to protocols specified in Section 3.2.1.2, Subsoil Sampling. No borings will be intentionally advanced into permafrost.

All well construction materials (such as well casings, screens, sand, bentonite, etc.) will be provided by the drilling contractor. Well screens and casing will be delivered to the site clean and wrapped in plastic; any casing or screen delivered without wrapping must be steam cleaned at the equipment decontamination area and wrapped in plastic for delivery to the well location. Casing and screen sections will be kept covered until they are assembled and lowered into the borehole. The well construction materials will be delivered to a designated staging area at the site and inventoried. Tetra Tech personnel have provided specifications to the drilling contractor for all well construction materials used on the project prior to their acquisition and shipment.

Screen and Casing Construction and Placement

Monitoring wells will be constructed using 2-inch i.d. Schedule 40 PVC casing and screen. Well screens will consist of 0.02 inch slot size for wells installed at the beach sites and 0.01 inch slot size for wells installed at locations on the tundra hill.

Screen and casing sections with flush threaded, O-ring sealed joints will be employed for well construction, and will be screwed together during well construction. No glue or mechanical couplings will be used. Wells will be sealed at the bottom with a threaded PVC sump and at the top with a PVC well cap. Screen and casing assembly's will be kept plumb and centered in the hollow stem while being lowered using stainless-steel centralizers, if necessary.

Shallow groundwater monitoring well screened intervals will be sufficient to encompass seasonal variations in the elevation of the groundwater surface; the proposed minimum screened interval is five feet. The screened interval of the shallow wells will be approximately 0.5 ft above and 4.5 feet below

the water table at the time of installation. Groundwater monitoring wells completed at intermediate depths will have screened intervals placed approximately 10-15 feet below the water table.

Filter Pack Material Determination and Placement

Unless otherwise specified, all monitoring wells will include an artificial filter pack consisting of either 10-20 or 20-40 silica sand. The 10-20 sand will be used in monitoring wells constructed at the beach sites if a filter pack is deemed necessary. The 20-40 sand will be used for the construction of wells in the finer-grained material typical of the tundra hill. It is possible that subsurface conditions could mandate a filter material and screen slot size smaller than those present onsite (ordered in advance). In this case, the well screen will be wrapped with a filter cloth material designed to prevent fine-grained sediment from entering the well.

Filter pack material will be carefully added to the borehole annulus using a tremie pipe to avoid bridging of the filter pack material between the casing and the hollow stem of the auger. The volume of filter pack material required will be calculated. If the volume used is less than it should be, it indicates possible sand bridging or slumping of the borehole wall against the screened interval. Potable water will be poured down the annulus to break any bridges and prevent later settling of the sandpack. The well will then be surged several times to settle the filter pack. The filter pack will extend a minimum of 6 in above the top of the screened interval. The sandpack will extend further above the screen at locations where the depth to groundwater permits compliance with the *IRP Handbook* requirement that the sandpack extend 2 ft above the top of the screen. At locations where the depth to groundwater is insufficient to meet this requirement, the placement of a bentonite seal of sufficient thickness to comply with State of Alaska and *IRP Handbook* well construction regulations will take precedence.

Bentonite Seal Placement

Following placement of the filter pack, granular or chip sodium bentonite will be placed to within one foot of the ground surface and hydrated to form a seal above the filter pack.

Well Head Completion

Well heads will be completed at grade (flush-mount) using an aluminum well cover set in a concrete surface seal. At least four inches of clearance will be maintained between the top of the well casing and the bottom of the steel protective cover. The identification number of each well will be permanently marked on the well cap and on the locking monument.

Surveying

Monitoring wells will be surveyed according to specifications presented in Section 3.1.8, Surveying. The elevation of newly installed wells will be surveyed at ground surface and at the water level measurement point (notch) on the riser pipe (TOC).

3.1.4.2 Well Development. Each newly installed monitoring well will be developed no sooner than 24 hours and no later than 5 days after completion. Well development will be done using a combination of bailing or pumping and surging with a surge block. No water, including recycled formation water, will be added to the well during development. Typically, well development will be performed by the drilling contractor under the supervision of a Tetra Tech geologist. The drilling contractor will provide the development equipment, including pumps, bailers, surge blocks, and drums for purged water containment. Tetra Tech will provide and operate monitoring instruments, including a PID, explosimeter, electronic water level indicator, temperature/pH meter, interface probe, turbidity meter, conductivity meter, Imhoff cone, and same-keyed locks. The following procedure will be employed for well development:

1. Remove well casing cap and monitor air in the breathing zone and well bore with PID and explosimeter. PID and explosimeter reading action levels and associated response actions established in the companion Health and Safety Plan will be followed.
2. Sound the well and record the measured depth to water and total depth relative to the top of the casing (TOC) using an electronic water level indicator. Calculate and record the volume of water in the well using procedures and calculations specified in Section 3.2.1.7, Groundwater Sampling; for 2-inch i.d. casing, 1 ft of water = 0.16 gal.

3. Compare the total depth with the well installation depth recorded on the well construction data sheet to determine the amount of fine sediment that has settled in the bottom of the casing.
4. After purging about 5 gallons of water with a bailer, take the first turbidity, temperature, pH, and conductivity measurements. Record these values, along with the time and the volume purged, on the well development form.
5. If the turbidity is over 200 NTU, fill an Imhoff cone and allow it to settle for at least 30 minutes. Record the volume/time of settleable solids on the form.
6. Continue bailing the well and probing the bottom until as much of the fine sediment is removed from the well as is possible; record the total well depth and water level at this time. Record a cumulative, running total of the volume of water purged in the "gallons purged" column of the well development form.
7. Begin surging with a surge block to flush fine-grained sediment from the filter pack. Surging can be done over the entire screened interval at once, or in smaller increments, working upward from the bottom of the screen.
8. Sound the bottom of the well again for sediment that may have settled during surging. Continue to take periodic instrument readings as bailing continues. The well development process is completed when the well sump is free of sediment and when measured values have stabilized between consecutive readings for temperature, pH, and conductivity as follows:
 - Temperature $\pm 1^{\circ}$ C
 - pH ± 0.1
 - Specific conductivity ± 5 percent
 - Turbidity less than 5 NTU

9. Wells may be installed that, because of formation conditions, do not clean up after a number of rounds of bailing and surging. If the required parameter levels still have not been reached after 25 casing volumes have been removed, well development can cease. Record the final set of readings and close the well. If the well is bailed dry and allowed to recharge, note this on the well development form.
10. All well development equipment will be decontaminated between well locations according to specifications in Section 3.1.9. Waste water generated during well development will be handled as detailed in Section 3.1.10.

3.1.5 Aquifer Testing

Slug tests will be conducted in the six intermediate-depth (screened completely below water table) monitoring wells installed in the vicinity of the ST05-Beach Tanks Site to evaluate aquifer characteristics associated with the Kotzebue Sound beach area (see Figure 2-3). The slug tests will consist of both rising-head and falling-head tests performed using a slug designed for 2-in i.d. monitoring well construction. Water level conditions will be static prior to conducting individual slug tests. All downwell aquifer testing equipment will be decontaminated prior to initial use and between well locations using procedures described in Section 3.1.9, Decontamination Procedures.

Monitoring wells will be instrumented with calibrated pressure transducers [10 or 15 pounds per square inch (psi)] and connected to a data logger system used to continuously record groundwater level fluctuations during testing. Data loggers will be programmed for slug testing prior to field installation and activation. Data loggers will be initially programmed for a sample frequency of five seconds for the duration of the slug test due to the relatively high hydraulic conductivities anticipated in the Kotzebue Sound Beach area. If it is determined that hydraulic conductivities are lower than anticipated (i.e., extended water level recovery time) the sample frequency may be decreased. The data will be analyzed using the Bower-Rice method for unconfined aquifers to provide estimates of hydraulic conductivity. The following procedure will be used to perform slug tests:

1. Remove well casing cap and monitor air in the breathing zone and well bore with a PID and explosimeter. PID and explosimeter reading action levels and associated response actions established in the companion Health and Safety Plan will be followed. Record the reading levels and any actions taken in the field logbook.
2. Record the pressure transducer serial number used for each well together with calibration data for the transducer. Install a pressure transducer in monitoring well to a depth below the static water level necessary to avoid contact with the slug when introduced to the well. Ensure that the pressure transducer depth is installed within the psi calibration range of the transducer. Secure the transducer communication cable to the well casing or protective monument with duct tape so that the pressure transducer cannot move and remains in the same position throughout the slug test.
3. Connect pressure transducer communication cable to data logger system and monitor continuous water level readings to ensure proper operation. Record the channel of the data logger used for each transducer/well in the field logbook.
4. Measure and record the static water level relative to TOC using an electronic water level indicator prior to conducting a slug test. Begin recording static water level measurements at 1 minute sample intervals for baseline data prior to conducting slug test. Make sure that the baseline data are stable.
5. Begin the slug test by activating the data logger sample program. Immediately introduce the slug to the well by lowering the slug below the water table (falling-head test). Record the start time of the test.
6. Monitor the instantaneous rise and subsequent falling of the water level in the well during data collection. Continue the falling-head test until the water level in the monitoring well has recovered to a minimum of 90 percent of the baseline static water level, or for a minimum of five minutes, whichever is longer in duration.

7. Begin the rising-head test by rapidly removing the slug from the well while continuing data collection and water level monitoring. The rising-head slug test may be terminated when the water level in the monitoring well has recovered to a minimum of 90 percent of the baseline static water level, or for a minimum of five minutes, whichever is longer in duration. Measure and record the static water level relative to TOC using an electronic water level indicator at the termination of the slug test.
8. Prior to removing the pressure transducer from the monitoring well, confirm that data collection and records were successfully recorded. Copy the slug test data from the data logger memory to diskette and confirm complete information transfer.
9. Remove the transducer from the monitoring well and decontaminate all downwell equipment between well locations using procedures described in Section 3.1.9. Check the serial number, data port (channel), and well designations recorded in the field logbook.

3.1.6 Tidal Monitoring

Tidal monitoring will be conducted in shallow and intermediate depth wells installed at the ST05-Beach Tanks Site to evaluate the influence of tides on the near-beach aquifer system. Tidal influence can directly affect aquifer hydraulic characteristics and geochemistry, influencing contaminant migration and potentially impacting the evaluation of remedial alternatives.

Four monitoring wells (3-shallow and 1-intermediate) will be instrumented with calibrated pressure transducers (either 10 or 15 psi) and connected to a data logger system to continuously record ground-water level fluctuations during tidal monitoring. In addition to monitoring wells, a standpipe will be installed and surveyed TOC at the shoreline at Site ST05 to provide baseline tidal data for comparison with tide chart predictions and well response records. Figure 2-3 presents the monitoring wells proposed for use during tidal monitoring.

Data loggers will be programmed and synchronized for tidal monitoring prior to field installation and activation. Data loggers will be programmed for a sample frequency of 10 minutes for the duration of the test. Tidal monitoring will be conducted for a 48-hr period to encompass four complete diurnal tide cycles. All downhole tidal monitoring equipment will be decontaminated prior to installation according to specifications in Section 3.1.9. The following procedure will be used to perform tidal monitoring:

1. Remove well casing cap and monitor air in the breathing zone and well bore with a PID and explosimeter. Record the readings in the field logbook. PID and explosimeter action levels and associated response actions established in the companion Health and Safety Plan will be followed.
2. Record the transducer serial number, psi range calibration data, and well designation in the field logbook. Install the pressure transducers in selected monitoring wells and the standpipe to a minimum depth of 3 feet below the baseline water level. Ensure that the pressure transducer installation depth is within the psi calibration range of the transducer. Secure the transducer communication cable to well casing or protective monument with duct tape so that the pressure transducer does not move and remains in the same position throughout the monitoring period.
3. Connect the pressure transducer communication cables to the data logger ports and monitor continuous water level readings to ensure proper operation. Measure and record the initial TOC water level using an electronic water level indicator prior to conducting tidal monitoring. Record the channel of the data logger used for each transducer/well in the field logbook.
4. Activate the data logger tidal monitoring program and record start time in logbook. After 30 minutes monitor all channels to confirm data has been collected at a 10 minute frequency.
5. Terminate tidal monitoring after 48 hours. Prior to removing the pressure transducer from the monitoring well confirm that data collection was successful and complete. Copy

the tidal monitoring data from the data logger memory to diskette and confirm complete information transfer.

6. Remove the transducer from the monitoring well and decontaminate all downwell equipment using procedures described in Section 3.1.9. Check the serial number, data port (channel), and well designation recorded in the field logbook for each monitoring point.

3.1.7 Gradiometric Survey

This section of the Field Sampling Plan describes the equipment and procedures that will be employed to conduct the gradiometric survey at Site SS02-Waste Accumulation Area No. 2/Landfill. The gradiometric survey will be conducted to identify the presence or absence of buried ferrous objects and their location. The extent of buried metal debris detected during the survey will be used to establish the boundaries of the waste accumulation area/landfill.

The gradiometric survey will be conducted using a Ferro-Trak™ magnetic locator, (Model No. FT-60). This hand held locator contains two magnetic sensors. The two sensors are used to balance out the effect of the Earth's magnetic field. As it is passed over the ground surface, it reacts to changes in the ambient magnetic field caused by the proximity of the lower sensor to buried ferrous metallic objects. These changes are displayed as an audio signal and on a meter built into the locator. The gradiometric survey will be conducted using the following procedures:

1. Lay out a right-angle grid on 25-foot spacings oriented parallel to the long axis of the waste accumulation area/landfill. Mark the corners of the grid with survey markers.
2. Zero the locator in an area where buried metallic objects are not anticipated to be present. Adjust the gain control to maximize the instrument sensitivity.
3. Walk the grid lines with the instrument, recording on a site map locations where buried metallic objects are identified and the intensity of instrument response. The instrument operator will, to the maximum extent possible, remove all metallic objects from their person when operating the gradiometer to avoid spurious instrument responses. The

person recording instrument responses/locations should take similar precautions and maintain at least a 10 feet buffer distance from the instrument operator.

The gradiometric survey crew will produce a map of the waste accumulation area/landfill indicating locations where buried ferrous metal objects are present and including the intensity of response to define areas with significant accumulations of ferrous debris.

3.1.8 Surveying

All sample, monitoring well, and borehole locations will be identified with markers for surveying purposes. These markers will contain the sample or borehole designation. Access to all groundwater monitoring wells will also be provided for surveying purposes. Surveying at the Kotzebue LRRS site will be conducted by USAF personnel, and will incorporate the following:

- All surveyed locations shall be measured by a certified land surveyor as the distance in feet from a reference location that is tied to the state-plane coordinate system.
- The surveys shall be third order.
- An xy-coordinate system shall be used to identify survey locations. The x-coordinate shall be the east-west axis, the y-coordinate shall be the north-south axis.
- The elevation of the ground surface will be surveyed at each location to ± 0.1 ft accuracy; monitoring well TOC elevations will be surveyed to within ± 0.01 ft. The elevation of all newly installed wells will be surveyed at the water level measuring point (notch) on the top of well casing (TOC).
- The reference location established for the Kotzebue LRRS site will be the origin.
- Tetra Tech personnel will remain at the Kotzebue LRRS site until all surveying is completed and assist the survey crew as needed.

3.1.9 Decontamination Procedures

The companion Health and Safety Plan presents the procedures that will be used for personnel decontamination. These decontamination procedures, and equipment decontamination procedures presented below, are consistent with guidelines established in the *IRP Handbook*. A portable decontamination station will be set up at each sampling location for the field personnel.

3.1.9.1 Equipment Decontamination. All equipment that comes in contact with potentially contaminated soil, sediment, or water will be decontaminated prior to and after each use.

Large Equipment

The following procedures shall be used to decontaminate large pieces of equipment such as drill rigs, auger flights, and well casing. These procedures shall be performed before the equipment is used and between each drilling or sampling location.

1. Wash the external surfaces of equipment with a high-pressure hot water wash. If necessary, scrub gross contamination from the equipment by brushing with an Alconox solution. The inside surfaces of casing, drill rod, and auger flights will also be washed as described above. Casing, screen, couplings, and caps used in monitoring well installation will be steam-cleaned prior to installation.
2. Rinse with the high-pressure hot water (potable).
3. Containerize all waste decontamination fluids as described in Section 3.1.10, Investigation Derived Waste Management.

Small Tools and Sampling Devices

The following procedures shall be used to decontaminate small tools and sampling devices such as split spoons, bailers, hand-augers, stainless-steel sample spoons, and bowls.

1. Wash the equipment with a solution of potable water and alconox.
2. Thoroughly rinse with potable water followed by a Type II Reagent Grade water rinse.
3. Rinse equipment with pesticide-grade methanol.
4. Rinse equipment with pesticide-grade hexane.
5. Air dry equipment on a clean surface such as PTFE, stainless steel, or oil-free aluminum. If the sampling device will not be used immediately after being decontaminated, wrap it in oil-free aluminum foil for storage.
6. Containerize and segregate all waste decontamination fluids as described in Section 3.1.10, Investigation Derived Waste Management.
7. Repeat entire procedure or any parts of the procedure as necessary.

Field Instruments

The following procedures shall be used to decontaminate field instruments such as tapes, well sounders, transducers, and water quality probes.

1. Wash the equipment with a solution of potable water and Alconox. Generally, only the wetted end of these devices will require cleaning provided it is washed and rinsed prior to being reeled onto the takeup spool.
2. Thoroughly rinse with potable water followed by a Type II Reagent Grade water rinse
3. Rinse equipment with pesticide-grade methanol.
4. Rinse equipment with pesticide-grade hexane.

General Decontamination Considerations

The decontamination procedure used will depend on the location of the sampling operation, the type of equipment being decontaminated, the degree of contamination present on the equipment, and the intended use of the equipment. Where possible, decontamination will be carried out at the sampling site. For major decontamination operations, a centralized decontamination station will be established at the Kotzebue LRRS site.

Type II Reagent Grade water, methanol, and hexane will be purchased, stored, and dispensed only in glass, stainless steel, or PTFE containers with PTFE caps or cap liners. All field personnel shall wear respirators equipped with organic vapor cartridges while handling or using methanol and hexane for decontamination purposes. The aluminum foil sold in stores is usually coated with a film of vegetable oil. Oil-free foil will be obtained from scientific supply houses.

3.1.10 Investigation Derived Waste Management

Subsoil sampling, groundwater monitoring well installation, groundwater sampling, and decontamination of field equipment will all generate investigation-derived wastes (IDW), including wastewater, soils, and protective clothing. The minimization of investigation-derived wastes is an important objective when planning the design of field sampling activities. Wastes produced during the investigation will be managed as described the following section.

3.1.10.1 Containment. All IDW will be containerized in 55 gal drums and segregated by type and matrix (soil, wastewater, etc.). The waste drums shall be sealed and secured at the end of each work day. The waste drums will be labeled with a description of the waste matrix, origin of the waste (e.g. borehole number, etc.), the volume or quantity of waste, the activity that generated the waste, the date(s) the waste was generated, the site or AOC name, and the name and telephone number of a USAF contact. An IDW logbook will be maintained to clearly identify and record all IDW generated during the field investigation. An onsite staging (containment) area for IDW will be identified by Tetra Tech, Inc. and approved by the USAF Technical Project Manager prior to the commencement of field work.

Soils

Waste soils generated during drilling will be properly contained in sealed open-top drums, properly labeled, and stored onsite. Waste soils will be segregated by site/area of concern location. The origin (i.e., borehole designation) of soils comprising a given drum of IDW will be identified on the drum and in the IDW logbook. Alternatives for soil disposal will be evaluated based on sample analytical results and criteria described in Section 3.1.10.2, Waste Characterization and Disposition.

Soil generated during the hand-augering of near-surface soil samples will be returned directly to the shallow hand-augered boring. These shallow borings cannot be advanced in permafrost, and thus will not unduly promote the vertical migration of potential contamination.

Decontamination Wastewater

All decontamination wastewater will be containerized in drums, properly labeled, and stored onsite. At the completion of RI/FS field activities, the decontamination waste water will be pumped through an in-field carbon filtration system, recontainerized, and sampled for diesel-range TPH, VOCs, SVOCs, pesticides and PCBs to evaluate potential hazardous constituents. Alternatives for decontamination wastewater disposal will be evaluated based on sample analytical results and criteria described in Section 3.1.10.2.

Groundwater

Wastewater generated during monitoring well installation and groundwater sampling will be containerized in drums, properly labeled, and stored onsite. Alternatives for groundwater disposal will be evaluated based on sample analytical results and criteria described in Section 3.1.10.2.

Personal Protective Equipment and Used (Spent) Equipment

Personal protective equipment (PPE) including gloves, tyvek, respirator cartridges, and other used equipment (e.g., sample containers, disposable samplers, field test kit residuals) will be sealed in plastic bags, containerized in drums, properly labeled, and stored onsite. Alternatives for disposal will be evaluated based on sample analytical results for various media and criteria described in Section 3.1.10.2.

3.1.10.2 Waste Characterization and Disposition. An initial evaluation of IDW disposal alternatives will be based on review of field sample analytical results associated with site/location-specific IDW. In order to determine appropriate IDW disposition in accordance state and federal regulations, sample analytical results will be evaluated to: 1) determine if constituents are classified as a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA); and 2) compare against established state and federal health-based standards.

Under RCRA , a waste is hazardous if it is a listed waste or is defined as possessing characteristics which classify it as a hazardous waste (e.g., ignitability, corrosivity, reactivity, and toxicity). Based on a review of previous IRP investigation information regarding contaminant releases at Kotzebue LRRS, it is assumed that all IDW will pass the tests for ignitability, corrosivity, and reactivity without conducting specific tests. IDW will be initially evaluated for toxicity characteristics by comparing field sample analytical results to RCRA toxicity characteristics (TC) regulatory criteria. If the total constituent concentration of a solid waste is greater than 20 times the TC regulatory criteria, then the waste is likely TC hazardous; for liquids, if the total concentration is greater than the TC regulatory criteria, the waste is likely to be TC hazardous (53 Federal Register 51444, December 21, 1988; and 40 CFR Part 261 Section 1.2 Appendix II).

Tetra Tech will assist the USAF with arrangements for the final disposition of the wastes generated in the course of the investigation as instructed by USAF. However, the USAF is ultimately responsible for final disposition of the wastes.

Soils

If IDW soils indicate a potential for exceeding TC criteria based on the initial evaluation of field sample analytical results described above, a sample will be collected from associated drummed wastes and submitted for Toxicity Characteristic Leaching Procedure (TCLP) analysis. Final disposition of the IDW will be based on comparisons of existing analytical data to TC criteria, TCLP analytical results (if required), and state and federal health-based criteria assessment.

Potentially TPH contaminated soils could be added to the existing landfarm and treated with other TPH contaminated soils. Soils containing contaminants in addition to those identified in samples from the landfarm will be segregated and further evaluated for disposal alternatives.

Decontamination Wastewater

Final IDW wastewater disposition will be based on a comparison of specific wastewater analytical results to TC criteria, and an assessment of state and federal health-based criteria.

Groundwater

IDW groundwater disposition will be based on a comparison of field sample analytical results to TC criteria and an assessment of state and federal health-based criteria. Drummed IDW groundwater that exhibits elevated concentrations of VOCs, SVOCs, or TPH may be pumped through an in-field carbon filtration system, recontainerized, and resampled to determine if hazardous constituent concentrations are below specified criteria. Disposal alternatives for filtered wastewater will be evaluated based on the sample analytical results obtained for these samples.

Personal Protective Equipment and Used (Spent) Equipment

Alternatives for PPE and used equipment disposal will be based on the assessment and disposition of media specific (e.g., soil and wastewater) IDW.

3.2 ENVIRONMENTAL SAMPLING

This section details the standard operating procedures (SOPs) to be implemented in conducting field sampling at Kotzebue LRRS. These procedures were developed by Tetra Tech to provide a consistent format for conducting reliable field investigations, and to ensure that the field effort is completed in an accurate, cost-effective, and reproducible manner. The following section details sample collection procedures, sample custody protocols, the field QA/QC program, a summary of sample analyses, identifies field measurements and discusses instrument calibration, record keeping procedures, and site management.

3.2.1 Sample Collection Procedures

The following sections describe procedures the field sampling team will follow to collect samples of soil, sediment, surface water, groundwater, seawater, and geotechnical samples. These procedures are designed to assure that samples are representative of field conditions and that they are identified, preserved, and transported properly to retain sample integrity.

3.2.1.1 Surface and Near-Surface Soil Sampling. Soil samples will be selected for analysis either from zones of obvious contamination identified by field screening procedures (see Section 3.1.2.1), the base of gravel fill material, the tundra mat/silt interface, or the top of the permafrost. The rationale used for the selection of the chosen sampling interval will be recorded in the field logbook. Surface (0 to 1.0 ft) and near-surface soil samples (1.0 to 6.0 ft below ground surface) will be collected using the following procedures.

1. Label the sample containers with all necessary information (see Section 3.2.2.1, Sample Labeling). Remove the vegetation layer and any surface debris (e.g., stones, twigs, leaves) from the specific sample location. Record surface conditions in the field logbook.
2. A clean stainless steel 2-in i.d. hand-auger will be used to collect discrete near-surface soil samples. Surface soil samples can be collected with any decontaminated stainless-steel device (spoon, trowel, scoop, etc.), including a hand-auger.
3. Samples to be submitted for VOC analysis will be collected first using the following procedures designed to minimize potential volatilization.
 - Insert brass or stainless-steel sample liners into the hand-auger and auger into the sampling horizon until the liners are filled with soil.
 - Remove the hand-auger from the ground and carefully remove the sample liners. If sufficient sample is not obtained, repeat. If multiple sample liners are required from a single sampling point, collect additional samples immediately adjacent to the first. Sample material will be screened for the presence of VOCs as described in Section 3.1.2.1, Field Screening.

- Seal each end of the sample liner with PTFE sheets, cover with plastic end caps, and secure with PTFE tape to prevent moisture and volatile loss. Clean the outer surface of the sample liner and affix a completed sample label securely.
 - Place the sample liner into a clean plastic bag and seal. Immediately place the properly labeled and sealed sample liners in a cooler with ice and maintain at 4⁰ C for the duration of the sampling and transportation period.
4. Sample material obtained for the remaining analytes (other than VOCs) will be collected using the following procedure:
- Remove soil from the sample horizon with a hand-auger or other device and place it directly into a clean stainless-steel mixing bowl until sufficient material is present for the proposed analyses.
 - Mix the soil in the bowl thoroughly with a stainless-steel spoon. All organic material, rocks, and pebbles greater than 0.5 inch maximum dimension will be excluded during mixing.
 - Fill prelabeled sample jars with equal portions of soil from each quadrant of the mixing bowl. Replicate samples will be collected concurrently. Seal each sample jar with the appropriate lid.
 - Place the properly labeled and sealed sample containers in a cooler with ice and maintain at 4⁰ C for the duration of the sampling and transportation period.
5. Record soil sample characteristics in the field logbook or field boring log (see Section 3.1.3, Lithologic Descriptions and Logging). Record all sample collection information (e.g., location, sample identification, sample type and depth collected, etc.) as described in Section 3.2.2.1, Sample Labeling and Section 3.5, Recordkeeping.
6. Follow sample custody and handling procedures as described in Section 3.2.2, Sample Custody.

7. Decontaminate all soil sampling equipment between sample locations according to procedures described in Section 3.1.9, Decontamination Procedures.
8. Replace residual soil cuttings into the hand-auger boring and replace the vegetated layer. Place a labeled survey marker identifying the sample location prior to leaving as described in Section 3.1.8, Surveying.

3.2.1.2 Subsoil Sampling. Borings for subsoil sampling will be advanced using a mobile track-mounted drill rig equipped with 4.25-inch i.d. hollow-stem augers. Borings will be advanced using standard drill-and-drive techniques. Standard penetration test data will be recorded for each sample drive in blows per 6 in. A registered geologist will supervise the drilling and will prepare lithologic logs of borings using the USCS as described in Section 3.1.3, Lithologic Descriptions and Logging.

Required drilling permits will be obtained prior to the commencement of drilling. The signed permits (or copies thereof) will be kept at the site during drilling. Because of the presence of permafrost at Kotzebue LRRS, all utilities are above-ground structures. Therefore, underground clearances and/or utility location are not required. Drilling will be conducted at least 20 feet from overhead electrical lines. If contact is made with any manmade underground structure, drilling will immediately stop and the borehole will be abandoned according to protocols specified in this section. No borings will be advanced into permafrost.

Site safety monitoring will be performed continuously throughout the drilling operation, with PID readings taken in worker breathing zones and of borehole exhaust at intervals specified in the Health and Safety Plan. Action levels for PPE upgrades are also specified in the Health and Safety Plan. If action levels are reached, it is the responsibility of the Tetra Tech health and safety officer to make sure that all personnel don the appropriate equipment and, if necessary, to stop drilling and cover the hole until the work can be completed by people wearing the appropriate level of protection, or until the problem subsides.

Subsoil Sample Collection

Undisturbed subsoil samples will be collected at 2.5 ft sample intervals using the Standard Penetration Test procedure split-spoon method. Sample material will be selected for laboratory analysis from zones of obvious contamination and based on field screening information (see Section 3.1.2.1). The rationale used for sample selection will be recorded in the field logbook and/or on field boring log, including field screening results. No subsoil samples will be submitted for analysis below the zone of saturation. Undisturbed subsoil samples will be collected using the following procedures.

1. Label the appropriate sample containers with all necessary information (see Section 3.2.2.1, Sample Labeling). Drive a clean, standard, 18-inch long, split-spoon sampler equipped with 1.5-inch diameter brass or stainless-steel sample liners, into the soil a distance of 18-inch at the chosen depth interval, using a 140 lb hammer, free falling 30-inches. Record the number of blow counts on the field boring log.
2. The drillers will relinquish the unopened sampler to the sampling crew when a split-spoon sample is collected. The drillers' gloved hands should never come in contact with the sample liners. Place the sampler on a clean, flat surface such as a stainless-steel pan or oil-free aluminum foil covered surface, and separate the two halves of the split-spoon.
3. Neatly cleave the soil between adjacent liners with a clean stainless-steel trowel or knife and insert the tip of the PID between adjacent liners in the split-spoon sampler immediately upon retrieval and separation of the sampler. Record the PID response on the boring log.
4. Remove the sample liners from the sampler. Record the total sample recovery on boring log.
5. Seal each end of the sample liner to be submitted for VOC analysis with PTFE sheets, cover with plastic end caps, and secure with PTFE tape. Clean the outer surface of the sample liner and affix completed sample label securely. Place sample liner into a clean plastic bag and seal. Immediately place the properly labeled and sealed sample liners in a cooler with ice and maintain at 4° C for the duration of sampling and transportation to the laboratory, replenishing the ice as necessary.

6. Place the remaining sample material for analyses other than VOCs directly into a clean stainless-steel mixing bowl until sufficient material is present for the proposed analyses. Mix the soil in the bowl thoroughly with a stainless-steel spoon. All organic material, rocks, and pebbles greater than 0.5 inch maximum dimension will be excluded during mixing. Fill prelabeled sample jars with equal portions of soil from each quadrant of the mixing bowl. Replicate samples will be collected concurrently. Seal each sample jar with the appropriate lid. Place the properly labeled and sealed sample containers in a cooler with ice and maintain at 4° C for the duration of sampling and transportation to the laboratory.
7. Record soil sample characteristics in field boring log (see Section 3.1.3, Lithologic descriptions and logging). Record all sample collection information (e.g., location, sample identification, sample type, depth collected, etc.) in the field logbook or in field boring log as described in Section 3.2.2.1, Sample Labeling and Section 3.5, Recordkeeping.
8. Follow sample custody and handling procedures as described in Section 3.2.2, Sample Custody.
9. Decontaminate all soil sampling equipment between sample locations according to procedures described in Section 3.1.9, Decontamination Procedures.
10. All borings will either be completed as monitoring wells or will be abandoned according to State of Alaska abandonment regulations. Boreholes will be abandoned using pressure grouting techniques. If the grout migrates into the adjacent formation due to the presence of high permeability zones, the borehole will be backfilled using bentonite chips, then hydrated to form a seal. All abandoned boreholes will be grouted to within approximately 1 ft of ground surface, and completed to ground surface with cement to form a surface seal.
11. Place a labeled survey marker identifying the boring location prior to leaving as described in Section 3.1.8, Surveying.
12. Place all soil cuttings, used protective clothing, and decontamination fluids in separate, properly labeled, sealed drums (see Section 3.1.10, Investigation Derived Waste Management). Store waste drums in a predetermined containment area onsite following the completion of the fieldwork.

3.2.1.3 Sludge Sampling. A sludge sample will be collected from the facility septic tank to evaluate the chemical characteristics of discharges to the former wastewater and sewage treatment system. The sludge sample will be collected using either PVC pipe or a stainless-steel scoop. The specific sampling technique will depend on the availability of sludge in the tank, the size and accessibility of the septic tank opening, and the oxygen content of the tank atmosphere. Sludge sampling will be conducted using the following procedure:

1. Inspect the septic tank and determine the appropriate tank access opening. Remove tank access cover (cap) and monitor air in the breathing zone and the tank opening with a PID and explosimeter, paying particular attention to the oxygen content of the tank atmosphere. Carefully monitor the air within the tank using an explosimeter (see Section 3.3, Field Measurements). Record the PID and explosimeter responses in the field logbook. The PID and explosimeter action levels and associated response actions established in the companion Health and Safety Plan will be followed.
2. Collect the sludge sample using either PVC piping or a stainless-steel scoop attached to wooden handle. The sludge sample will be placed directly into the appropriate prelabeled sample containers. The sample to be submitted for VOCs analysis will be collected first by filling the sample container as full as is practicable to eliminate headspace. The remaining sludge will be homogenized and placed in the appropriate sample containers. All sludge samples will be placed in a cooler with ice and maintained at 4° C for the duration of the sampling and transportation to the laboratory. Samples will be handled according to procedures described in Section 3.2.2, Sample Custody.

3.2.1.4 Geotechnical Sampling. Geotechnical samples will be collected from the primary lithologies that characterize the surficial geology of the Kotzebue LRRS, including beach sands, gravel fill, and native tundra. Geotechnical sampling will include bulk soil samples for grain-size analysis using ASTM Methods C136 and D422, and undisturbed soil samples collected using Shelby tubes for constant-head permeability testing (ASTM Method D5084). Geotechnical sampling will be conducted in areas determined to be free of contamination by the field team. In addition to geotechnical samples, one soil sample will be collected at each location for total organic carbon analysis using EPA Method 9060. Geotechnical samples will be collected using the following procedures detailed below.

Grain-Size Sampling

Bulk soil material will be collected for grain size-analysis using the following procedure:

1. Fill a one-gallon plastic container with soil material obtained by drilling or hand-auger sampling. Record soil sample collection information and soil characteristics in field logbook (see Section 3.1.3).
2. Seal the sample container and affix the sample label with clear tape. Grain-size samples do not require cooling.

Shelby Tube Sampling

Undisturbed subsoil samples will be collected for permeability analysis using the following procedure:

1. Drive a drill rig mounted Shelby sample tube at the selected sample interval.
2. Remove the Shelby tube from the sample stem and wipe down the sides of the sampler. Use a hacksaw or pipe cutter to remove the unfilled portions of the Shelby tube (if present) prior to plugging and capping the ends to prevent the sample from shifting inside the tube. Tape endcaps to the sample tube with duct tape to retain moisture content and integrity of the sample
3. Secure sample label to sample tube using clear tape. Mark the up direction on the outside of the tube with an indelible marker.
4. Place the Shelby tube sample in a shipping container designed to keep the tube vertical during shipment; the samples do not require cooling.
5. Place a labeled survey marker identifying the sample location prior to leaving as described in Section 3.1.8, Surveying.

3.2.1.5 Lake Sediment Sampling. Relatively undisturbed lake sediment samples will be collected from near-shore locations using either a stainless-steel modified 0.02 m² Ponar grab sampler or a hand-driven PTFE tube sample device by the following procedure:

1. Label the sample containers with all necessary information (see Section 3.2.2.1, Sample Labeling). Record lake characteristics and surface conditions in the field logbook.
2. Collect an undisturbed sediment sample using a Ponar grab or PTFE tube sampler within 5 ft of the existing shoreline. Place the sampler on a clean, flat surface. Immediately screen the sample for organic vapors using a PID and record the response in the field logbook. Observe the water surface for evidence of sheen created during sampling.
3. Transfer sediment samples that are required for VOC analysis directly from the sampler to the appropriate prelabeled sample container as soon as possible after the sampler is opened, to reduce sample volatilization. Carefully fill the VOC sample container leaving no headspace. Immediately place the properly labeled and sealed sample container in a cooler with ice and maintain at 4° C for the duration of sampling and transportation to the laboratory.
4. Remove the remaining sediment from the sampler and place it directly into a clean stainless-steel mixing bowl until sufficient material is present for the proposed analyses. Mix the soil in the bowl thoroughly with a stainless-steel spoon. All organic material, rocks, and pebbles greater than 0.5 inch maximum dimension will be excluded during mixing. Fill prelabeled sample jars with equal portions of sediment from each quadrant of the mixing bowl; replicate samples will be collected concurrently. Seal each sample jar with the appropriate lid. Place the properly labeled and sealed sample containers in a cooler with ice and maintain at 4° C for the duration of sampling and transportation to the laboratory.
5. Record sediment sample characteristics in the field logbook or on a field boring log (see Section 3.1.3, Lithologic Descriptions and Logging). Record all sample collection information (e.g., location, sample identification, sample type and depth collected, etc.) as described in Section 3.2.2.1, Sample Labeling and Section 3.5, Recordkeeping.

6. Follow sample custody and handling procedures as described in Section 3.2.2, Sample Custody.
7. Decontaminate all soil sampling equipment between sample locations according to procedures described in Section 3.1.9, Decontamination Procedures.
8. Place a labeled survey marker identifying the sample location at the nearest bank edge prior to leaving as described in Section 3.1.8, Surveying.

3.2.1.6 Surface Water Sampling. Surface water samples will be collected from lakes, standing water locations at Site SS12, and from Kotzebue Sound. Extreme care will be taken not to suspend sediment in the water prior to or during sampling. Surface water samples will be collected prior to collecting sediment samples at all lake locations. A Wheaton surface water sampler will be used to collect representative water samples from below the water surface using the procedure below.

1. Label the sample bottles with all necessary information (see Section 3.2.2.1, Sample Labeling). Inspect surface water conditions (e.g., sheen or discoloration) and record information in the field logbook or on a field data sheet.
2. Collect a water sample for field water quality measurements, including temperature, pH, specific conductivity, and geochemical parameters (if specified). Measure dissolved oxygen (if specified) *in situ* as described in Section 3.3, Field Measurements. Record all field measurement data in field logbook or on a field data sheet.
3. Collect surface water samples: 1) slowly lower the Wheaton sampler with attached sample bottle below the water surface, 2) remove sample bottle cap and fill, 3) recap the sample bottle below the water surface, and 4) retrieve sample.
4. Fill surface water sample containers in the order of volatilization sensitivity (i.e., VOCs samples first, then other organic compound samples, and inorganic samples last). In particular, VOC sample containers should be carefully filled to minimize turbulence and aeration, and must be absolutely free of bubbles, with no headspace. Exercise care to not overfill sample containers containing preservatives (HCl for VOCs, HNO₃ for metals). Place the properly labeled and

sealed sample containers in a cooler with ice and maintain at 4° C for the duration of the sampling and transportation period.

5. Record all sample collection information (e.g., location, sample identification, sample description, depth collected, etc.) in the field logbook or on a data sheet as described in Section 3.5, Record-keeping.
6. Follow sample custody and handling procedures as described in Section 3.2.2, Sample Custody.
7. Decontaminate all surface water sampling equipment between sample locations according to procedures described in Section 3.1.9, Decontamination Procedures.
8. Place a labeled survey marker identifying the surface water sample location at the nearest bank-edge prior to leaving as described in Section 3.1.8, Surveying.

3.2.1.7 Groundwater Sampling. Groundwater samples will be collected from newly installed near-beach monitoring wells. Monitoring wells will be completely developed and stabilized prior to sample collection (see Section 3.1.4, Monitoring Well Installation and Development). Groundwater will be purged from each monitoring well prior to sample collection using a clean stainless steel bailer. Groundwater sampling will be conducted in all monitoring wells using a clean 1-liter stainless-steel or Teflon bailer with dedicated bailer line (and a Teflon bottom-emptying device for VOC samples only) by procedures described below.

If floating product or sinking immiscible phase products are present in a well, the thickness and elevation of the product layer will be measured using a multiphase interface probe, and results recorded in the field logbook and/or on field data sheet (see Section 3.3, Field Measurements). If measurable floating product is detected in a well, a top-filling bailer will be lowered into the well and a floating product sample will be collected for analysis; if sinking product is present, a bottom-filling bailer or weighted tubing and a peristaltic pump will be used. Monitoring wells exhibiting measurable product will not be purged and sampled for water quality due to the unrepresentative nature of the water sample matrix in wells that contain product (unless specifically directed by the USAF).

Groundwater Purging

1. Inspect the monitoring well, making note of any damage or unusual conditions. Remove well cap and monitor air in the well bore and breathing zone with a PID and explosimeter. Follow PID and explosimeter action levels and associated response actions established in the companion Health and Safety Plan. Record air monitoring results and well condition information in the field logbook or on a field data sheet.
2. Measure groundwater surface level and total well depth from the elevation mark (notch) at top of well casing (TOC) using a calibrated water level indicator (see Section 3.3, Field Measurements). Record measurements in the field logbook or on a field data sheet. Calculate the volume of water in the well casing (in gallons) as follows:

$$\text{For 2-inch i.d. casing, casing volume} = \\ [\text{Depth to bottom of well (ft)} - \text{depth to water (ft)}] (0.16 \text{ gal/ft})$$

3. Lower a clean stainless steel bailer and collect the initial set of field parameters including temperature, pH, specific conductivity and turbidity from the first bailer of water removed from the well. Dissolved oxygen (D.O.) will be measured *in situ* prior to well purging activities for those wells selected for geochemical characterization (see Section 3.3, Field Measurement). Record all field parameter measurements in the field logbook or on a field data sheet.
4. Bail the well at a rate that will not cause water to cascade through the screen. Take an additional set of parameter readings after one casing volume has been removed from the well. While bailing, containerize all purge water.
5. Samples can be collected after a minimum of three well casing volumes have been purged from the well, but water quality readings must stabilize before sampling. Stabilization is defined as pH ± 0.1 , specific conductivity ± 5 percent between the last two readings (casing volumes) temperature $\pm 1^{\circ}\text{C}$, and turbidity <5 NTU.

6. If these parameters have not stabilized after three casing volumes have been purged, continue bailing the well. Take additional readings after purging each additional volume.
7. The sample can be collected after the parameters stabilize or six borehole volumes have been removed, whichever occurs first. Samples shall be collected after the water level has recovered to 80% of its static level or 16 hours after purging, whichever occurs first. An exception to the above rules occurs if the well is pumped dry before three casing volumes have been removed. In this case, the sample should be collected as soon as a sufficient volume of water has entered the well. The final water quality parameters for the sample are those values obtained for the last purge volume.

Groundwater Sample Collection

Field personnel collecting environmental samples during the RI/FS effort at Kotzebue LRRS will adhere to EPA-recommended preservation techniques for the parameters of concern (see Section 3.2.3; Table 3-1).

1. Label the sample bottles with all necessary information (see Section 3.2.2.1, Sample Labeling). Lower the bailer slowly until it contacts the water surface. Allow the bailer to sink with a minimum of disturbance to a point midway between the well bottom and the water surface.
2. Raise the bailer slowly to the surface after filling with groundwater.
3. Collect and containerize groundwater samples in order of volatilization sensitivity (e.g., VOCs samples first, then other organic compound samples, and inorganic samples last). VOC sample containers, in particular, should be filled carefully to minimize turbulence and aeration, and must be absolutely free of bubbles and with no headspace. Exercise care to not overfill sample containers containing preservatives (HCl for VOCs, HNO_3 for metals). Place the properly labeled and sealed sample containers in a cooler with ice and maintain at 4° C for the duration of the sampling and transportation period.

4. For wells selected for the analysis of geochemical parameters, collect field test kit parameters according to manufacturer specified procedures (see Section 3.3, Field Measurements). Record results in the field logbook or on a field data sheet.
5. Record all sample collection information (e.g., location, sample identification, sample description, depth collected, etc.) in the field logbook or on a data sheet as described in Section 3.5, Record-keeping.
6. Follow sample custody and handling procedures as described in Section 3.2.2, Sample Custody.
7. Decontaminate all groundwater sampling equipment between sample locations according to procedures described in Section 3.1.9, Decontamination Procedures.
8. Contain all purged groundwater and decontamination fluids in separate, properly labeled drums as discussed in Section 3.1.10, Investigation Derived Waste Management.

3.2.1.8 Seawater Sampling. The collection of seawater samples will be conducted using surface water sample collection procedures with the following modification.

- Seawater samples will be collected approximately 5 ft from the high tide shoreline from a level 0.7 tenths of the total depth below the water surface at this point.

3.2.2 Sample Custody

The sample custody procedures used for the Kotzebue LRRS RI/FS are based on EPA-recommended procedures. As a result, emphasis is placed on careful documentation of sample collection and sample transfer. To ensure that all important information pertaining to each sample is recorded, the documentation procedures described in the following sections will be implemented during the collection, storage, packing, and shipping of all environmental samples.

3.2.2.1 Sample Labeling. The sample identification scheme for the work effort at the Kotzebue LRRS is described in this section. Additional detail is provided in the relevant portions of the QAPP.

Sample Designation

Sample identification numbers are designated using a four-part code. This code is compatible with the cell requirements for input in IRPIMS. An example of a sample designation is described as follows:

SS12-SB5-10.7

where:

SS12	=	The specific site or AOC designation for the Kotzebue LRRS
SB5	=	The sampling activity (e.g., soil boring), and the location
10.7	=	The depth (ft) at which the sample was taken, or the sample round (see below).

Sample designation will include the following sample activity protocol:

■	SS	=	Surface soil
■	SB	=	Soil boring
■	SW	=	Surface water
■	GW	=	Groundwater
■	SD	=	Sediment

Subsoil samples will be numbered by sample depth for each borehole from the surface down. The depth designation used corresponds to the depth at the base of the core sample (in ft) estimated to the nearest tenth. For water samples, where a location may be sampled more than once, the consecutive number will indicate the sampling round. Duplicate samples will be labeled such that the analytical laboratory cannot identify the samples as such. All remaining QA/QC samples will be labeled as such in an obvious fashion.

The duplicate sample set will be labeled with a mock well number that will be used for identification on the chain of custody. There should be nothing on the label or on the chain of custody that might alert the laboratory that the sample is a duplicate. Include all information necessary to correlate and correctly identify and distinguish between samples in the field logbook.

The sample number, along with the date and time the sample was obtained, will be recorded on the boring log or field data sheet, and entered on the sample tag. For samples of any media that require multiple containers, a single sample number will apply to all containers for that sample. The sample number, along with the date and time the sample was obtained, will be recorded on the appropriate sample form or field data sheet, and entered on the sample label.

Samples will be tracked using a sample label including the following information:

- Project identifier and project number
- Sample designation (number)
- Date and time of sample collection
- Name of the sampler
- Sample matrix type and depth, as appropriate, at which the sample was obtained
- Analyses to be performed on the sample
- Preservative used
- For water samples, whether the sample is filtered or unfiltered.

Labels will be affixed to the brass or stainless steel liners and glass jars, plastic, or any other containers used to contain samples.

3.2.2.2 Sample Packaging and Shipping. All samples will be packaged carefully to avoid breakage or contamination, and will be shipped to this laboratory at proper temperature. The following sample packaging requirements will be followed:

- Sample bottle lids will not be mixed; all sample lids will stay with the original containers.
- All sample bottles will be wrapped in bubble pack or similar material and placed in plastic bags to minimize the potential for breakage or cross-contamination during shipment. Soil samples contained in brass or stainless steel liners will be placed in plastic bags. Volatile organic analysis sample containers will also be placed in plastic bags; activated carbon will not be used as a packaging material.

- Samples will be cooled unless "no cooling" has been specified. The sample containers will be packed in a chilled cooler. Empty space in the cooler will be filled with inert packing material. Under no circumstances will locally obtained material (sawdust, sand, etc.) be used.
- The Chain-of-Custody will be placed in a plastic bag and taped to the inside of the cooler lid.
- All coolers will be custody sealed and taped with filament tape for shipment to the laboratory.
- Samples collected for geotechnical analysis will be packaged in sturdy cardboard boxes with sufficient inert packaging material to prevent sample damage.

3.2.2.3 Sample Custody in the Field. The criteria for proper sample custody are presented below. The documentation for sample custody and the protocols for custody transfer are also discussed.

Sample Custody

The following custody procedures will be complied with to guarantee document sample custody. A sample will be considered under proper custody if:

- It is in actual possession of the responsible person
- It is in view, following physical possession
- It is in the possession of a responsible person and is locked or sealed to prevent tampering
- It is in a secure area.

Chain-of-Custody

Sample custody is maintained by a "Chain-of-Custody Record." The custody record is completed by the individual collecting the sample. Chain-of-Custody records will be completed for samples collected for chemical analyses and for samples collected for geotechnical analyses. The Chain-of-Custody is detailed as follows:

1. The Chain-of-Custody (COC) is the single most important form during any type of field sampling activity at the Kotzebue LRRS site. It is a continuously maintained custody record that travels with the samples at all times.
2. The COC must be signed off by each person responsible for shipping or otherwise relinquishing the samples to an outside laboratory or other agency. An example COC is shown in Appendix B. A violation of the COC protocols is a serious matter that can result in the affected sample set being invalidated.
3. The COC must always include the following:
 - Corporate name
 - Sampler names and signature
 - Project manager's name
 - The site designation
 - Sample designations
 - Sampling date
 - Sample collection times—these should be filled in on the COC as samples are collected
 - Analyses to be conducted on the samples
4. The schedule of tests to be run on the collected samples are summarized in Section 3.2.4, Summary of Sample Analyses. This information will be entered on the COC at the end of the sampling day before the samples are either stored or shipped.

5. The person(s) collecting the samples must sign the COC in the appropriate block at the end of the sampling day.
6. At this time, the labels on the sample containers should be checked against the COC to make sure there are no discrepancies between any of the information recorded on both.
7. If an error is found on a label or the COC, it should be lined through once, in ink, so the initial entry can still be read.
8. The correction should then be made in ink and initialed by the person making it.
9. When samples are held overnight or longer, the same comparison check should be made again by the person responsible for shipping them.
10. The person responsible for shipping the samples
 - must sign the topmost "relinquished by" block and
 - fill in the shipping date and time,
 - the number of sample containers,
 - the shipping container number(s),
 - the shipping bill number,
 - any special shipping requirements such as overnight delivery,
 - and the Tetra Tech storage time and temperature (if applicable).
11. The pink (back) copy must be retained for Tetra Tech records and returned to the project office together with Tetra Tech's copy of the shipping bill.
12. The remainder of the form must be placed inside the shipping container prior to being sealed for shipment.

Sample Storage

1. Protocols for handling and storing soil and water samples in the field are detailed in the sections of this document that pertain to field sampling procedures.
2. When samples are returned to the field office at the conclusion of sampling they will usually be prepared for shipment to the analytical laboratory that night. Should samples arrive at the field office too late for departure that night they will be kept chilled overnight in the ice chest they were placed in at the time of sampling. Field sampling will be scheduled such that samples will not require storage over the weekend.
3. Each ice chest should contain at least one temperature blank prepared following procedures discussed in Section 3.2.3.2, Field Quality Control Samples.
4. A sample shipping notebook will be kept at the site by the Field Operations Manager. This notebook is a permanent record of the samples stored or shipped from the site.
5. When preparing samples for shipment, record in the sample shipping notebook the following:
 - Time
 - Date
 - Sample IDs
 - Laboratory to which they are being shipped.
6. Initial all notebook entries.
7. When preparing stored samples for shipping the ice chest will be repacked with fresh blue ice and the temperature will be checked and recorded on the COC and sample shipping notebook. The best way to check the temperature is to open one of the temperature blanks and insert the thermometer in the water.

Shipping Supplies

The following items are needed for packing and shipping samples:

- Ice chest(s).
- "Blue ice" or equivalent (5 or 6 blocks per ice chest).
- Bubble wrap.
- Styrofoam packing material.
- Address labels.
- Nylon strapping tape.
- Temperature blank.
- Shipping bill.
- Custody seals.
- Large zippered freezer bags.

Sample Packing

1. Always wear nitrile liners when handling any sample containers or packing the coolers.
2. Check all container labels against the COC to make sure there are no discrepancies and both the labels and the COC are complete and legible.
3. Count the containers to make sure the number is recorded correctly on the COC.
4. Make sure all bottle caps are on tight.
5. If any samples were handled or treated in an unusual manner, make sure this is noted on both the sample and the COC.

Water Samples--

1. To wrap VOA bottles, tear off one sheet of bubble wrap.
2. Lay two VOAs end to end (not touching) on the sheet, roll sheet and VOAs into a tight cylinder, fold in the middle (between the bottles) and secure with tape.
3. Larger glass bottles, such as the one-liter amber jars, should be wrapped individually in three sheets of bubble wrap and secured with tape.

Soil Samples--

1. All metal sleeves containing soil from a single sample point should be sealed into plastic Ziploc bags. Whenever possible, use a single large bag for all sleeves from a single sample.
2. Never place sleeves from different samples in the same bag.
3. Different soil samples from the same site should always be placed in the same ice chest(s).
4. Trip blanks and ambient blanks from soil sampling sites must be packed with the soil samples.
5. No project water samples should ever be packed in the same shipping containers as soil samples.

Sample Placement--

1. Water samples collected from a single site should be packed together in the same set of ice chests. (Typically, more than one ice chest will be required when shipping water samples).

2. All VOA bottles from the site, including both trip blanks and samples, should be packed in the same ice chest.
3. One-liter bottles should be placed upright in the ice chest, not stacked, mixing the glass and plastic bottles wherever possible.
4. Wrapped VOAs can be placed on top of the upright containers if necessary, without overpacking the ice chest.
5. Place a temperature blank in each ice chest being shipped.
6. Place five or six completely frozen blocks of "blue ice" in each ice chest, distributing them evenly among the samples to insure an even temperature distribution in the ice chest.
7. Discard any "blue ice" that shows any sign of possible leakage.
8. Dry ice should not be used because it will tend to freeze the samples.
9. Water ice should not be used because it will melt during shipment and possibly contaminate the samples.
10. Fill all void spaces in the ice chests with clean styrofoam packing material.
11. Paper or cardboard should never be used as packing material.

Shipping Bill and Chain-of-Custody

1. Complete the shipping bill with shippers' and receivers' addresses, if these are not already printed on the bill.
2. Mark the bill for overnight delivery, if this is required.

3. Note the bill number in the appropriate box on the COC.
4. Next to each sample line on the COC, note the ice chest number the sample was placed in.
5. If multiple ice chests are being used, note which one contains the trip blanks and samples for volatile organic analysis.
6. Remove the back (pink) copy of the COC and set it aside.
7. Put the rest of the COC in a zippered freezer bag and place it in the corresponding ice chest.
8. If desired, the bag can be taped to the inside of the container lid.
9. Remove old labels, tape, etc., from the ice chests.
10. Attach the shipping bill to the top of the corresponding container.

Shipping Containers

1. Attach address labels to all shipping containers.
2. Make sure each container will close properly and that the drain is plugged.
3. Seal each container with strapping tape, wrapping the tape twice around the container at the hinge points.
4. Attach custody seals across the ends of the tape.
5. It is advisable to place "up" arrow stickers on the sides of containers holding water samples.

6. Transport the samples to the shipping carrier's location (Kotzebue Airport).
7. If asked about the contents, explain that they are soil or water samples being shipped for analysis.
8. The carrier's representative (Alaska Airlines) will give you a copy of the shipping bill.
9. Staple this to the retained copy of the COC.
10. Give both papers to the Field Operations Manager, or designee, who will circulate or file them as needed.
11. The Field Operations Manager will contact the Project Manager at the analytical laboratory by telephone to inform them of the anticipated arrival time at the local airport.

3.2.3 Field QA/QC Program

Quality control procedures associated with all sample collection procedures are an integral part of each sampling methodology. These procedures will be oriented to the collection of representative samples that are free of external contamination. The following section discusses sample handling, field activities quality control, analysis in the field, and field audit program and corrective actions.

3.2.3.1 Sample Handling. Field personnel collecting environmental samples during the RI/FS effort at Kotzebue LRRS will use EPA-recommended containers and adhere to EPA-recommended preservation techniques for the parameters of concern (Table 3-1). The minimum sample volumes required for each type of analysis are also specified and must be met. Precleaned sample containers for groundwater samples, containing the appropriate preservatives as specified in Table 3-1, will be provided by the source laboratory.

3.2.3.2 Field Quality Control Samples. Quality control (QC) sampling is conducted to ensure the reliability of project samples and usefulness of the analytical data. All quality control samples will be collected as described in this section of the Field Sampling Plan. Additional information regarding the number, analysis, and use of quality control and quality assurance samples is included in the companion

TABLE 3-1. RECOMMENDED SAMPLE CONTAINERS AND HOLDING TIMES FOR SELECTED METHODS
(Page 1 of 2)

Parameter	Container ^c	Volume Required ^a		Preservation ^b		Maximum Holding Times ^{e,f}
		Water (mL) ^d	Soil ^g	Water	Soil	
Metals (6010) ^g	P, G	1,000	50	Cool 4°C HNO ₃ to pH <2	4°C	6 months
Lead (7421) Modified ^g	P, G	100	10	Cool 4°C HNO ₃ to pH <2	4°C	6 months
Mercury (7470/7471) ^g	P, G	1,000	10	Cool 4°C HNO ₃ to pH <2	4°C	28 days
Total Petroleum Hydrocarbons (AK101, AK102)						
Gasoline	G	3 x 40	50	Cool 4°C HCl to pH <2	4°C	14 days
Diesel	G	1,000	50	Cool 4°C	4°C	14 days until extraction
Organochlorine Pesticides/PCBs (8081)	G, Teflon screw cap	1,000	50	Cool 4°C	4°C	7 days (water) and 14 days (soil) until extraction, 40 days after extraction
Volatile Organics (8260)	G, Teflon screw cap	3 x 40	50	Cool 4°C HCl to pH <2	4°C	14 days (7 days if not pH adjusted)
Semivolatile Organics (8270)	G, Teflon screw cap	1 x 1,000	50	Cool 4°C	4°C	7 days (water) and 14 days (soil) until extraction, 40 days after extraction
Total Organic Carbon (9060) Modified	G	100	10	Cool 4°C H ₂ SO ₄ to pH <2	4°C	28 days

TABLE 3-1. RECOMMENDED SAMPLE CONTAINERS AND HOLDING TIMES FOR SELECTED METHODS

(Page 2 of 2)

a	Additional Sample required for MS/MSD or replicate analyses.
b	Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automatic sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining them at 4°C until compositing and sample splitting are completed.
c	Polyethylene (P) or glass (G). Soil samples may be collected in either glass jars or stainless steel liners with both ends sealed with Teflon liner and plastic caps.
d	Do not prewash bottle with samples.
e	Samples should be analyzed as soon as possible after collection. The times listed are maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods of time only if the laboratory has data on file to show that the specific types of samples under study are stable for the longer time.
f	Extraction holding times are from date of sample collection; analysis times are from date of extraction.
g	If analyzing for dissolved metals, sample shall be filtered in the field through a 0.45 µm filter immediately (within 15 minutes) after sample collection and before sample preservation.
Source: This table includes the requirements of the U.S. Environmental Protection Agency, as published in the Code of Federal Regulations, Volume 49, Number 209, 40 CFR 136, dated October 26, 1984, page 43260.	

Quality Assurance Project Plan (QAPP). Any minor field changes to the QC sampling procedures will be documented in the field logbook. Modifications of the QC sampling procedures must be approved by the Technical Project Manager, Field Operations Manager, and USAF prior to implementation of the change. All modifications to existing QC procedures will be recorded by a memorandum to the project file. Quality control sampling procedures are detailed below.

Trip Blanks

One trip blank will accompany every cooler of environmental samples sent to the analytical laboratory for the analysis of VOCs. Trip blanks will be prepared using the following procedures:

- Trip blanks consist of two sealed 40 ml VOA sample bottles filled at the analytical laboratory with Type II Reagent Grade Water. The sealed trip blanks accompany the routine sample containers from the laboratory to the field, during sample collection, and during transport of the samples back to the analytical laboratory.
- Trip blanks will be analyzed for VOCs at the laboratory in conjunction with the associated field samples.

Temperature Blanks

One temperature blank will accompany every ice chest containing soil and water samples sent to the laboratory for chemical analysis. Temperature blanks will be prepared and evaluated using the following procedures:

- The temperature blanks will consist of one 100-mL VOA vials filled with Type II Reagent Grade Water and will be labeled temperature blanks.
- The sealed temperature blanks will accompany the routine sample containers during shipment from the field to the analytical laboratory.

- The temperature in the ice chest is checked by opening one of the temperature blanks and inserting a thermometer or thermocouple probe in the water. This provides a much more representative sample temperature than does the air temperature in the ice chest.

Ambient Condition Blanks

Ambient condition blanks will be collected at a 10 percent sample (VOC sample) frequency or one ambient condition blank will be collected for every volatile organic compound sampling event (whichever is fewer).

- Type II Reagent Grade Water will be used to fill two 40-ml VOA vials. The vials will be filled by pouring the lab water through the open air during sampling at each site and AOC. Vials will be filled on an intermittent basis during sampling, such that all four vials span the field sample collection activities at a given site or AOC.
- Upon completion of sampling at a given location, the blanks will be transported to the analytical laboratory using procedures discussed in Section 3.2.2, Sample Custody. Each set of ambient condition blanks will be shipped with a cooler containing field samples from the corresponding site or AOC.
- The ambient condition blanks will be analyzed for VOCs at the laboratory in conjunction with the corresponding field samples.

Equipment Rinsate Blanks

Equipment blank samples will be collected daily from sampling equipment used to collect 10 or more field samples. If less than 10 samples are collected within a day, equipment blanks will be collected based on a running cumulative total at a 10 percent frequency.

- Equipment rinsate blanks will be collected by pouring Type II Reagent Grade Water directly over decontaminated sample collection equipment and into the sample containers.
- The equipment rinsate blanks will be labeled and transported to the analytical laboratory using the procedures discussed in Section 3.2.2, Sample Custody.
- The equipment rinsate blanks will be analyzed for the same analytes as are specified for the associated field samples collected that day.

Field Duplicate and Replicate Samples

Ten percent of all water samples and ten percent of all soil/sediment samples collected, will be field duplicate or replicate samples. Field duplicate and replicate samples will be collected using the following procedures:

Water Duplicate Samples--

- Field duplicate water samples are obtained when as two samples are collected independently at the same sample location during a discrete sampling event. Field duplicate water samples will be collected by alternately filling both sample bottles for each analyte from the bailer (for groundwater samples) or directly from the surface water body (for surface water samples).
- Field duplicate water samples will be labeled such that laboratory personnel are unable to distinguish them from the associated field sample (see Section 3.2.2.1, Sample Labeling).
- Care will be exercised to document the association between each duplicate sample and the corresponding field sample, and to correctly record their sample designations in the field logbook.

- Field duplicate water samples will be transported to the analytical laboratory using the procedures discussed in Section 3.2.2, Sample Custody.
- The field duplicate water samples will be analyzed for the same analytes as are specified for the associated field samples.

Soil and Sediment Replicate Samples--

- Field replicate soil and sediment samples are obtained from a single sample that is collected, mixed, and divided into equal parts for the purpose of replicate analysis. Replicate soil and sediment samples (except for VOCs analysis which are discrete samples).
- Field replicate soil samples will be labeled such that laboratory personnel are unable to distinguish them from the associated field sample (see Section 3.2.2.1, Sample Labeling).
- Care will be exercised to document the association between each replicate and the corresponding field sample, and to correctly record their sample designations in the field log-book.
- Field replicate soil and sediment samples will be transported to the analytical laboratory using procedures discussed in Section 3.2.2, Sample Custody.
- The field replicate soil and sediment samples will be chemically analyzed for the same analytes as are specified for the associated field sample collected with the replicate.

3.2.3.3 Analysis Performed in the Field. Field measurements for alkalinity, ammonia, carbon dioxide, chloride anions, nitrate, nitrite, phosphate, sulfate, and sulfide will be accomplished using HACH Field Test Kits. The detection limits and calibration procedures for these field measurements are detailed in Table 3-2. Direct measurements will also be performed in the field and include temperature (EPA Method 170.1), pH (EPA Method 150.1), specific conductance (EPA Method 120), and dissolved oxygen. Field measurement procedures are detailed in Section 3.3, Field Measurements.

**TABLE 3-2 FIELD INSTRUMENTATION, METHODS,
DETECTION LIMITS, AND CALIBRATION PROCEDURES**

Analyte	Model Number	Method of Analysis	Detection Range (mg/L)	Calibration Procedure
Hach Test Kit, Model Number S:				
Alkalinity	AL-DT	Digital Titration Against Sulfuric Acid	10-4,000	Digital Titration to Color Change
Ammonia	NI-SA	Colorimetric Against Salicylite	D-2.5	Compare to Color Disk and Record Value from Scale
Carbon Dioxide	CA-23	Titration Against NaOH and Phenolphthalein	1.25-100	Drop Count Titration to Color Change
Chloride (two levels)	8-P	Titration Against Silver Nitrate	5-100 20-400	Drop Count Titration to Color Change
Nitrate	NI-1.1	Colorimetric With Cadmium Reduction	D-1.0	Compare from Color Disk and Record Value from Scale
Nitrite	NI-15	Colorimetric with Diazotization	D-0.5	Compare from Color Disk and Record Value from Scale
Phosphate	PO-19	Colorimetric with Ascorbic acid	D-50	Compare from Color Disk and Record Value from Scale
Sulfate	SF-1	Extinction and Turbidimetric Processes	50-200	Graduated Scale Read Through Turbidity
Sulfide (single level)	HS-C	Color Chart Against Carbonate Reaction with Hydrogen Sulfide	D-5	Comparison to Color Chart
Sulfide (multi-level)	HS-WR	Colorimetric Against Methylene Blue	D-0.55 D-2.25 D-11.25	Compare to Color Disk and Record Value from Scale
Direct Measurement Instrumentation:				
Conductivity	EPA Method 120, Model YSI 3000	Selective Ion Electrode	D-50,000 ^a	Calibrate as per Manufacturer's Instructions
Dissolved Oxygen	YSI Model 51B	Selective Ion Electrode	D-15	Calibrate by either Winkler Titration, Air Method, or Saturated Water Method
pH	EPA Method 150.1, Model Orion SA 250	Selective Ion Electrode	(-2)-19.9 ^b	Autocalibration to Manufacturer's Specification
Temperature	EPA Method 170.1, Model YSI 3000	Thermometer	-2° C-50 C°	Calibrate as per Manufacturer's Instructions
Notes: D = Limit of Detection.				
^a Units are in micromhos/cm.				
^b By convention, no units are used for pH.				

Field equipment and testing kits will be calibrated prior to use (as relevant), in the field as detailed in Table 3-2. This will ensure that equipment used in the field will function within the tolerable range specified by the manufacturer, within the range required by the project, and that field tests are accurately employed. Periodic calibration records will also be recorded and filed in a calibration logbook. All instruments will be monitored for evidence of nonreproducible or erratic readings, and recalibration will be performed as necessary. Calibration requirements are detailed in Section 3.4, Instrument Calibration and Maintenance. Copies of the instrument manuals will be readily accessible for all field personnel. All records of calibration results will be subject to audit by Tetra Tech's Field QA Auditor.

All instruments are to be stored, transported, and handled with care to preserve equipment accuracy and minimize downtime. Damaged instruments shall be taken out of service immediately and not used again until a qualified technician repairs and recalibrates the instrument.

3.2.3.4 Field Audit Program. Periodic audits of field activities of both Tetra Tech, Inc. staff and subcontractors will be performed by the Tetra Tech, Inc. QA Field Auditor or QA staff member. The QA audits will be conducted as soon as possible after a project phase begins. The function of the field QA audit will be to:

- Observe procedures and techniques used in the various measurement efforts, including field sampling and analysis
- Check and verify instrument and sampling equipment calibration records are in place
- Assess the effectiveness of and adherence to the prescribed QA procedures
- Review document control and Chain-of-Custody procedures including the completion of the Chain-of-Custody form
- Review the completeness of data forms and notebooks
- Review any nonconformance reporting procedures

- Identify any weakness in the sampling/analytical approach and techniques
- Assess the overall data quality of the various sampling/analytical system employed at the time of the audit.

Based on the audit results, the Tetra Tech, Inc. QA Field Auditor may, as necessary, initiate corrective action at the project level through the QA/QC Project Manager to the Project Manager. A checklist for relevant components of the audit will be filled out by the QA Auditor during the audit. Examples of the general sampling are shown in Figure 3-2. Upon completion of the audit, the QA Auditor will discuss any specific weakness or nonconformances with the field team and make recommendations for corrective actions. An audit report will be prepared to include the relevant checklist and distributed to the Tetra Tech, Inc. QA/QC Project Manager and Project Manager. This report will outline the audit approach and present a summary of results and recommendations. The Program Manager is responsible for responding to any deficiencies.

3.2.4 Summary of Sample Analyses

The proposed sample analysis activities will be used to determine the nature, magnitude, and extent of contamination at sites, specifically address whether natural biodegradation is actively occurring at sites, and support a contaminant fate and transport assessment. This section provides a summary of proposed analyses in support of the contaminant, natural biodegradation, and fate and transport assessments. A detailed description of each analytical method to be conducted at Kotzebue LRRS is provided in the QAPP.

3.2.4.1 Contaminant Assessment. Proposed sample analyses for existing sites and newly identified areas of concern are summarized in Table 3-3, including the estimated number of samples for each media, sample type, and the number of analyses and analytical methods for each sample, and the estimated distribution of quality assurance/quality control (QA/QC) samples. Analyte selection for Kotzebue LRRS sites was based on a review of previous IRP site characterization information and on the identification of additional data needed to support baseline risk assessment and other tasks. Analyte selection for areas of concern is based on suspected and potential hazardous substance(s) associated with the historical area use and/or operations at each AOC.

**ENVIRONMENTAL SAMPLING
SYSTEMS AUDIT CHECKLIST
RI/FS, KOTZEBUE LRRS**

Contract: _____ Date: _____

Site: _____ Auditor: _____

Yes	No	Comments	Operation
<u>PRESAMPLING OPERATIONS</u>			
_____	_____	_____	1. Sample type? (specify)
_____	_____	_____	2. Qualified personnel?
_____	_____	_____	3. Adequate facilities, equipment, and supplies?
_____	_____	_____	4. Sampling locations properly specified?
_____	_____	_____	5. Copy of task instructions or QAPP? Revision # _____
_____	_____	_____	6. Copy of daily sampling schedule?
<u>SAMPLING OPERATIONS</u>			
_____	_____	_____	1. Samples collected at proper sampling locations?
_____	_____	_____	2. Rinse probe with DI H ₂ O prior to placement?
_____	_____	_____	3. Purge appropriate volume prior to sampling (3 well volumes) For this well # _____ = _____ gallons.
_____	_____	_____	4. Appropriate sample technique used to obtain representative sample?
_____	_____	_____	5. Appropriate techniques used to ensure sample integrity and avoid contamination?
_____	_____	_____	6. At least 10% duplicate samples collected?

Figure 3-2 Environmental Sampling Systems Audit Checklist Samples Collected During the RI/FS Investigation of Kotzebue LRRS. (page 1 of 2)

Yes	No	Comments	Operation
_____	_____	_____	7. Sufficient volume of sample collected?
_____	_____	_____	8. Suitable sample container used for storage?
_____	_____	_____	9. Sample bottles properly labeled?
_____	_____	_____	10. Sampling data sheet completed in a timely manner? (Within five minutes of activity.)
_____	_____	_____	11. OVA measurements taken and recorded prior to sampling and every 30 minutes during sampling?
<u>POST-SAMPLING OPERATIONS</u>			
_____	_____	_____	1. Decontamination performed according to current procedure? (Soap, potable water, Type II, reagent grade water, methanol, hexane.)
_____	_____	_____	2. Well capped immediately following removal of pump and prior to decontamination?
_____	_____	_____	3. Sampling date, time, and location properly recorded in logbook?
_____	_____	_____	4. Suitable sample shipping container label used?
_____	_____	_____	5. Chain-of-Custody form filled out?
_____	_____	_____	6. Chain-of-Custody seal affixed to sample container?
_____	_____	_____	7. Refrigerated sample storage?
_____	_____	_____	8. Overall recordkeeping procedure adequate?

Additional comments: _____

Figure 3-2 Environmental Sampling Systems Audit Checklist Samples Collected During the RI/FS Investigation of Kotzebue LRRS. (page 2 of 2)

TABLE 3-3. PROPOSED FIELD SAMPLING AND ANALYSES SUMMARY
KOTZEBUE LRRS, ALASKA

Site Designation	Media	Number of Samples	Proposed Analyses							
			TPH Residual Range (AK102 Extended)	TPH Gasoline Range (AK101)	TPH Diesel Range (AK102)	VOC (8260)	SVOC (8270)	PCB (8081)	Pesticides (8081)	Metals ^a (6000, 7000)
SS02-Waste Area No. 2/ Landfill	Soil	3	TBD ^b		3	3	3	3	3	3
	Groundwater	3			3	3	3	3	3	6
ST05-Beach Tanks	Sediment	20	TBD		20	10	10		3	
	Groundwater	15			15	15	15			
	Seawater	3			3	3	3			
SS07-Lake	Sediment	3			3	1	3	3	3	3
	Surface Water	3			3	1	3	3	3	2
Lake Access	Soil	2						2	2	
SS08-Barracks Pad	Soil	4 to 8			4 to 8	3 to 5	3 to 5		3	2
SS11-Fuel Spill	Soil	5			5	5	5		5	
SS12-Spills No. 2 and 3	Soil	30			30	10	10		10	
	Groundwater	1			1	1	1		1	
	Surface Water	3			3	3	3		3	
AOC1-Landfarm	Soil	6	TBD		6	3	3		3	2
Landfarm Seeps	Soil	4 to 8			4 to 8	4 to 8	4 to 8		4	2
AOC2-POL Lines	Soil	3 to 8			3 to 8	3 to 8	3 to 8		3	
AOC3-East Tanks	Soil	3 to 6			3 to 6	3 to 6	3 to 6		3	
AOC4-Power Plant/Garage	Soil	4 to 8	TBD	4 to 8	4 to 8	4 to 8	4 to 8	4	4	2
AOC5-Small Day Tanks	Soil	12 to 20			12 to 20	12 to 20	12 to 20		12 to 20	
AOC6-Nav. Aid Building	Soil	3 to 6			3 to 6	3 to 6	3 to 6	3	3	2
AOC7-Steel Pilings	Soil	3 to 6			3 to 6	3 to 6	3 to 6	3	3	2
AOC8-White Alice Garage	Soil	3 to 6	TBD	3 to 6	3 to 6	3 to 6	3 to 6	3	3	2
AOC9-White Alice Tanks	Soil	3 to 6			3 to 6	3 to 6	3 to 6		3	
AOC10-Septic Holding Tank	Soil	0 to 3			0 to 3	0 to 3	0 to 3	0 to 3	0 to 3	0 to 3
	Sediment	1			1	1	1	1	1	1
Background Characterization	Soil	3	TBD	3	3	3	3	3	3	3
	Lake Sediment	3			3	3	3	3	3	3
	Beach Sediment	3			3	3	3	3	3	3
	Groundwater	3			3	3	3	3	3	6
	Surface Water	3			3	3	3	3	3	6
	Sea Water	1			1	1	1			
Total Number of Project Samples	Soil	89 to 134	TBD	10 to 17	89 to 132	65 to 106	65 to 106	21 to 24	67 to 78	20 to 23
	Sediment	30			30	18	20	10	13	10
	Groundwater	22			22	22	22	6	7	12
	Surface Water	9			9	7	4	6	9	8
	Seawater	4			4	4				
QA/QC Samples	Trip	15 to 30				15 to 30				
	Ambient	15 to 20				15 to 20				
	Equipment	20 to 35		5 to 10	20 to 35	20 to 35	20 to 35	20 to 35	20 to 35	20 to 35
	Duplicate ^c									
	• Soil/Sediment	12 to 20		1 to 2	12 to 19	8 to 13	8 to 13	3 to 5	8 to 12	3 to 6
	• Water	4			4	3	3	2	2	3

^a Metals analysis for water samples will include total and dissolved.

^b TBD = To Be Determined (residual range organics to be evaluated based on AK102 analytical results revealing the presence of heavier end hydrocarbons).

^c Duplicate samples collected at 10 percent frequency.

3.2.4.2 Natural Biodegradation Assessment. A suite of geochemical parameters are scheduled for the analysis of water samples collected at two sites at Kotzebue LRRS, groundwater at the ST05 Beach Tanks Site, surface water at the SS12 Spills No. 2 and 3 Site, and for a background surface water body (lake). Sampling at both sites will include a minimum of three samples collected along a flow path, comprised of both upgradient and downgradient samples, with both proximal and distal downgradient samples collected and analyzed. At the Beach Tanks Site, dual completion monitoring wells will be used to also evaluate geochemical and contaminant trends vertically in the upper portion of the aquifer.

Table 3-4 presents the geochemical analytical suite proposed for this portion of the RI/FS field investigation. The table includes several parameters that will be measured in the field using either portable instrumentation (e.g., pH, DO, etc.), or field test kit analyses (CO₂, chloride, alkalinity, etc.). The analyte list has been adapted from a draft technical protocol developed by AFCEE for the evaluation of natural biodegradation at sites contaminated with petroleum hydrocarbons (Wiedemeier et al. 1994).

3.2.4.3 Fate and Transport Assessment. Three primary lithologies characterize the Kotzebue LRRS: beach sands and gravels, native soils associated with the tundra hill and surrounding area, and fill material used for roads and facility foundations. To support the contaminant migration assessment for each lithology, Tetra Tech proposes to collect up to three geotechnical samples from each lithology to evaluate physical properties, including permeability and grain size distribution. If a representative (undisturbed) sample cannot be obtained from the coarse beach sands and gravels, only grain size distribution samples will be collected for analysis. In addition to geotechnical information, three soil samples from each lithology will be collected for the analysis of total organic carbon (TOC) to evaluate the potential for contaminant sorption within specific lithologies. The following tests are proposed for geotechnical and TOC characterization:

Test	Test Method	Number of Samples		
		Beach Sands/Gravels	Tundra	Fill
Soil Permeability	Constant-head (ASTM Method D5084)	3	3	3
Grain Size Distribution	ASTM C136 and D422	3	3	3
Total Organic Carbon (soil)	EPA Method 9060	3	3	3

**TABLE 3-4. PROPOSED FIELD SAMPLING AND ANALYSES SUMMARY
FOR GEOCHEMICAL PARAMETERS
KOTZEBUE LRRS, ALASKA**

Proposed Analyses	Site Designation			
	ST05-Beach Tanks	SS12-Spills No. 2 and 3		Background
Media	Groundwater	Surface Water	Groundwater	Surface Water
Alkalinity (Field Test)	12	3	1	1
Ammonia (Field Test)	12	3	1	1
Chloride (Field Test)	12	3	1	1
Carbon Dioxide (Field Test)	12	3	1	1
Nitrate (Field Test)	12	3	1	1
Phosphate (Field Test)	12	3	1	1
Sulfate (Field Test)	12	3	1	1
Sulfide (Field Test)	12	3	1	1
Total Metals Fe/Na/Ca/K/Mg (EPA Method 6010)	12	3	1	1
Total Organic Carbon (EPA Method 9060)	12	3	1	1
pH (Field Measurement)	12	3	1	1
Temperature (Field Measurement)	12	3	1	1
Specific Conductivity (Field Measurement)	12	3	1	1
Dissolved Oxygen (Field Measurement)	12	3	1	1

3.3 FIELD MEASUREMENTS

This section of the Field Sampling Plan discusses procedures for the collection of field measurements and the use of field parameter test kits. Operation manuals provided by the manufacturer will accompany each field instrument and test kit. A complete set of all operation manuals will also be kept by the Field Operations Manager or his designee.

3.3.1 Water Temperature and pH Measurements (Orion Model SA 250)

The Orion pH meter is equipped with an automatic temperature compensator, therefore no conversion will be required for the pH readings obtained during the field survey. pH and water temperature will be measured using the following procedure:

1. Check the battery level prior to meter use. Carry a spare battery pack and a screwdriver into the field in the pH meter case.
2. Calibrate the pH meter as discussed in Section 3.4, Instrument Calibration and Maintenance.
3. Triple rinse a 500-mL plastic beaker and pH and temperature electrodes with small volumes of sample water.
4. Pour the water sample into the pre-rinsed 500-mL beaker and immerse the temperature and pH electrodes in the sample while swirling, to provide for thorough mixing.
5. Switch the meter to the temperature setting. Read the temperature to nearest 0.1°C and record in field logbook or on a field data sheet.
6. Switch the meter to the pH setting using the 0.01 span. Read pH to nearest 0.1 unit once the reading has stabilized, and record the result in the field logbook or on a field data sheet.

3.3.2 Conductivity (YSI Model 33)

Field conductivity will be measured using the following procedure:

1. Check the battery level prior to meter use. Carry a spare battery pack and a screwdriver into the field in the specific conductance meter case.
2. Zero the instrument using reagent grade distilled water as a blank.
3. Calibrate the meter as discussed in Section 3.4, Instrument Calibration and Maintenance.
4. Triple rinse a 500-mL plastic beaker and conductivity probe with small volumes of sample water.
5. Pour the water sample into the pre-rinsed 500-mL beaker, and immerse the conductivity probe in the sample while swirling, to provide for thorough mixing.
6. Switch the meter to the temperature setting. Read the temperature to the nearest 0.5° C and record the result in the field logbook or on a field data sheet. Adjust the instrument temperature dial to the measured value to provide for automatically compensated conductivity readings.
7. Select the highest sensitivity conductivity span setting that produces a conductivity reading. Read the conductivity from the dial and record in the field logbook or on a field data sheet.

3.3.3 Dissolved Oxygen (YSI Model 51B)

The YSI Model 51B will be used to measure *in situ* dissolved oxygen concentrations in the field using the following procedure:

1. Check the battery prior to meter use. Carry a spare battery pack and a screwdriver into the field in the dissolved oxygen meter case.

2. Calibrate the dissolved oxygen probe using the manufacturer's instructions for air calibration at the beginning of each day of use. Record the calibration information in instrument logbook.
3. Set the instrument in the position in which measurements will be taken and zero the instrument.
4. Insert the probe into water column and allow the probe to equilibrate. (For shipboard monitoring, lower the weighted probe into the water column and record the oxygen reading every 2 meters.) Select the appropriate temperature scale and record temperature to the nearest 1° C.
5. Adjust the oxygen solubility factor dial to the sample temperature.
6. Select the oxygen reading setting. Record the dissolved oxygen concentration in mg/L in the field logbook or on a field data sheet.

3.3.4 Turbidimeter

A HACH Portable Turbidimeter will be used to measure turbidity in groundwater monitoring wells using the following procedure:

1. Check the battery prior to meter use. Carry a spare battery pack and screwdriver into the field in the instrument case.
2. Select the middle span scale (1-10 NTU).
3. Zero the instrument using the blanks provided.
4. Insert the 10 NTU standard and adjust the scale to read 10 NTU.
5. Rinse the sample tube a minimum of three times with sample water.

6. Agitate the sample actively. Make sure that all oxygen bubbles have dissipated. Pour the sample into the sample tube. Immediately take the turbidity reading and record in the field logbook or on a field data sheet. Obtain a duplicate reading.
- 7a. Low Turbidities: If sample reading is too low (off scale), switch the span setting to 0-1 NTU and calibrate the meter to the 1 NTU standard.
- 7b. High Turbidities: If the sample reading is too high, switch the span setting to 10-100 NTU and calibrate the meter using the 100 NTU standard. Dilution is recommended for samples falling within this range or higher. Dilute the sample with distilled water until it falls within the 1-10 NTU range; record dilution information in the field notebook or on a field data sheet.

3.3.5 Depth to Groundwater Surface

A Solonist electronic water level indicator will be used to measure depth to groundwater surface in monitoring wells using the following procedure:

1. Switch on the water-level probe and check the audible indicator tone with the test button. Ensure that the tape and probe have been decontaminated prior to placing in well.
2. Lower the tape gradually into the well until the tone sounds, indicating contact with the water surface.
3. Hold the graduated tape to the mark at top of well casing (TOC) and adjust it to read, to the nearest 0.01 ft, the depth to water surface.
4. Record the depth to water below TOC in the field logbook or on a field data sheet.
5. Withdraw the probe up the well, then lower and repeat Steps 2 through 4. If readings differ by more than 0.01 ft, repeat until readings stabilize.

6. Remove the probe from well. Decontaminate the measuring tape and probe prior to reeling the tape onto the spool using procedures described in Section 3.1.9.

3.3.6 Immiscible Product Thickness in Wells by Interface Probe (ORS Model 100 EN/M)

An ORS interface probe will be used to measure the immiscible product thickness in groundwater monitoring wells using the following procedure:

1. Before activating the probe, attach the grounding clip to a suitable earth ground. Ensure that the probe and tape have been properly decontaminated prior to placing in well.
2. To turn the unit on, unfold the crank handle away from the reel housing. This activates the power switch inside the instrument.
3. To verify that the unit is operational, press the test button on the face plate. If the power is on, a solid tone will sound. A low battery light will indicate if battery replacement is necessary. Replacement batteries will be kept in the meter case.
4. To release the probe, pull the protector tube outward from the reel casing. To lower the probe, tilt the front of the reel housing forward and press the brake release, located just forward of the handle. The tape will descend as long as the brake release is depressed. Note that the tape should not be allowed to rub against the well casing, as this could damage the tape.
5. When the probe contacts liquid, a tone will sound. An oscillating tone indicates water, a steady tone indicates product. To determine the exact thickness of a floating product layer, the probe should be moved, slowly and carefully up and down so that the alarm goes from no tone to a steady tone. The exact point where the tone goes steady should be read from the tape, using the mark on the well casing as a reference, and recorded in the field logbook. Take care to avoid disturbance of the floating layer and mixing the two liquids in the well.

6. The probe should then be lowered until the alarm tone starts oscillating. The probe should be moved very slowly and carefully down until the exact point from where the tone goes from steady to oscillating is found. Only one or two chances are sometimes possible before mixing precludes a stable reading. Subtracting the first reading from the second reading gives the thickness of the floating product layer. Record all values in the field logbook.
7. To determine the thickness of sinking immiscible product in the well, the probe should be lowered further until the alarm goes from an oscillating tone to a steady tone. The probe should be moved very slowly up and down so the alarm goes from oscillating tone to steady tone. The exact point where the tone goes steady should be read from the tape, and recorded in the field notebook. Avoid mixing the two fluids. Measure the depth to the bottom of the well, and subtract the depth to the top of the sinking product from this to determine the thickness of the sinking immiscible product layer in the well. Record all values in the field notebook.
8. While reeling in the tape, use a paper towel to clean the portion of the tape that did not contact liquid in the well.
9. Remove the probe from the well, but do not reel in, the portion of the tape and probe that contacted product and/or groundwater in the well. Place the tape and probe in a bucket, wash with an Alconox solution, and rinse with Type II Reagent Grade Water. Solvents (e.g., hexane, methanol) and a small brush may be required to remove some immiscible products from the tape and probe (see Section 3.1.9, Decontamination Procedures).

3.3.7 Photoionization Detector (PID)

Two types of photoionization detectors (Hnu and Photovac MicroTIP HL2000) will be used to measure total ionizable volatile organic vapors in the field as follows:

1. Check the battery level each time the meter is used. Make sure that both battery packs are fully charged overnight prior to going into the field. Two fully charged batteries are sufficient for a full day of operation.
2. Turn the meter on and allow it to warm up.
3. Calibrate the meter as discussed in Section 3.4, Instrument Calibration and Maintenance. The meter will require periodic calibration checks using a standard calibration gas throughout the day. This is particularly important if temperature or weather conditions change.
4. Once calibrated, the meter is ready to use. Meter readings are in parts per million relative to the concentration of the calibration gas, and should be recorded as units, not ppm. Record all readings in the field logbook or on appropriate field data sheets.

3.3.8 Explosimeter (MSA Model 260)

The MSA Model 260 provides measurements of percent oxygen and percent lower explosive limit (LEL) using the following procedure:

1. Turn the meter on and allow it to warm up.
2. Press the check button and observe the % LEL meter. If the LEL reading is less than 80 percent, the battery packs must be recharged.
3. Calibrate the meter as discussed in Section 3.4, Instrument Calibration and Maintenance.
4. Check the meter air flow by briefly placing a finger over the air inlet. If the flow indicator does not drop, check the flow system for leaks according to the manufactures' guidelines.
5. Once calibrated, the meter is ready to use. Record all readings in the field notebook or on a field data sheet.

3.3.9 Ferro-Trak Magnetic Locator

The Ferro-Trak Magnetic Locator will be used to identify buried metallic debris during gradiometric surveys using the following procedure:

1. Check the battery level each time the locator is used. Carry a spare set of batteries into the field in the locator's case.
2. Zero the locator in an area where buried metallic objects are not anticipated to be present. Zero and span the instrument according to the manufacturer's instructions.
3. The locator is now ready for use. Record readings in field logbook or on appropriate field data sheets.

3.3.10 Data Loggers

A Terra 8 and/or Aquistar multi-channel data logger will be used to collect water level data during aquifer testing and tidal monitoring activities. Refer to the manufacturer-provided equipment manual for the proper operation of the data logger used.

3.3.11 Field Test Kits

Field measurements for alkalinity, ammonia, carbon dioxide, chloride, nitrate/nitrite, phosphate, sulfate, and sulfide will be conducted on selected groundwater monitoring well samples and surface water samples using HACH Field Test Kits (see Section 3.2.3.3; Table 3-2). HACH Field Test Kit measurements will be conducted according to manufacturer specified procedures provided with the individual test kits.

3.4 INSTRUMENT CALIBRATION AND MAINTENANCE

Procedures described in this section pertain to the calibration of instruments and field test kits used during field investigations. The descriptions include the procedure to be used, or a reference to an applicable standard operating procedure, the calibration frequency, the calibration standards to be used, and general instrument maintenance.

All field instruments requiring calibration have accompanying dedicated (instrument-specific) calibration logbooks (see Section 3.5, Record Keeping). Field instrument and test kit calibrations will be performed according to the manufacturer's standard calibration procedures provided with individual instruments and test kits. Recalibration of instruments will be conducted as needed, following the manufacturer guidelines. All Tetra Tech personnel should be familiar with the proper procedures for maintaining, calibrating and operating the various instruments and other items of equipment prior to entering the field. If field personnel are unfamiliar or unsure about a particular piece of equipment, they are to contact the Field Operations Manager or designee for instruction.

All equipment will receive routine maintenance checks in order to minimize equipment breakdowns in the field. Any items found to be inoperable will be taken out of use, and a note stating the time and date of this action will be made in the field logbook. Inoperable equipment will be repaired or replaced, and the time and date of its return to service noted in the field logbook.

3.4.1 Temperature/pH

pH meter calibration will be achieved using factory or laboratory-supplied buffer solutions of pH range 4, 7, and 10. Buffer solutions will be renewed daily and used prior to and following each day's use. The pH meter is automatically temperature corrected, and pH readings can be directly read from the instrument. Check temperature probe, on a weekly basis, against NIST-calibrated field thermometer. Agreement should be within 0.5° C.

Calibrate pH meter according to manufacturer's instructions at the beginning of each day of fieldwork when pH will be measured. Recalibrate the pH meter during the day whenever a battery is replaced or if the meter is stabilizing slowly between readings. At the end of each day, recalibrate the pH meter; this provides a means of establishing drift (if any) in pH measurements. Record all calibration information in the instrument calibration logbook.

General maintenance includes the following:

- Check the battery level prior to meter use. Carry a spare battery pack and a screwdriver into the field in the meter case.

- Store the pH meter with the probe immersed in distilled water at all times. When storing pH meter over an extended period of time, use the manufacturer-provided solution in the meter case or reagent-grade distilled water for the pH probe.

3.4.2 Conductivity

The specific conductance meter is calibrated by the manufacturer. However, meter calibration will be checked each day prior to use as follows:

1. Rinse a 500-mL plastic beaker and conductivity probe with reagent-grade distilled water, followed by a rinse using the standard solution.
2. Fill the pre-rinsed 500-mL beaker with fresh standard solution and immerse the conductivity probe while swirling.
3. Switch the meter to the temperature setting. Adjust the instrument temperature dial to the measured value to provide automatic temperature compensation readings.
4. Compare the measured conductivity to the actual conductivity of the standard solution. If there is a difference of more than 10 percent between the two values, the meter should be sent to the manufacture for recalibration. Record all information in the instrument calibration logbook.

General maintenance includes the following:

- Check the battery level prior to meter use. Carry a spare battery pack and a screwdriver into the field in the meter case.
- Store the meter with the conductivity probe immersed in distilled water.

3.4.3 Dissolved Oxygen

Calibrate the dissolved oxygen meter using manufacturer-provided instructions for air calibration at the beginning of each days use. Record all calibration information in the logbook provided with the instrument.

General maintenance includes the following:

- Check the battery level prior to meter use. Carry a spare battery pack and a screwdriver into the field in the meter case. Replace batteries after 1,000 hours of operation.
- Replace the probe membrane every 2-4 weeks if in heavy use.

3.4.4 Turbidity

Calibrate the turbidity meter at the beginning of each day following procedures outlined in the manufacturer-provided manual. Turbidity standards provided with the meter include 1.0, 10, and 100 NTU standards. Record all calibration information in the calibration logbook provided with the instrument.

General maintenance includes the following:

- Check the battery level prior to meter use. Carry a spare battery pack and a screwdriver into the field in the turbidity meter case.

3.4.5 Water Level and Interface Probes

Electrical sounder probe calibration will be accomplished by checking graduations against a steel surveyor's tape prior to use. The graduated steel tape will be calibrated using manufacturer-supplied temperature correction (if applicable) for field conditions.

3.4.6 Portable Gas Analyzers (PID and Explosimeter)

Two types of portable gas analyzers are currently recommended for field operations, including photo-ionization detectors and an explosimeter. These instruments will be used for general qualitative survey tasks and calibration will be performed using manufacturer recommended calibration-gas standards and

in calibration procedures manufacturer-supplied manuals. All calibration information will be recorded in the instrument-specific calibration logbook.

3.4.7 Field Test Kits

HACH Field Test Kit calibrations will be conducted according to manufacturer-specified procedures provided with individual test kits. The detection limits and calibration methods for these field measurements are detailed in Section 3.2.3.3; Table 3-2.

3.5 RECORDKEEPING

This section discusses the records to be maintained by field personnel during the Kotzebue LRRS RI/FS work effort, including recordkeeping protocols for basemaps, daily field logbook entries, field forms, photographs, and sample custody and handling.

3.5.1 Basemaps

The field sampling team will maintain basemaps of Kotzebue LRRS, including identified sites, areas of concern, and background characterization locations. These basemaps will be used to plot observed contamination, sample locations, or other pertinent information. The basemaps will be photo-copies made from good originals. Field data will not be plotted on basemap originals, which will be maintained in a file by the Field Operations Manager as copy masters.

3.5.2 Field Logbook

All information pertinent to a field and/or sampling survey will be recorded on appropriate data sheets and in a project field logbook. This field logbook will be a waterproof, bound book with consecutively numbered pages. Entries in the logbook will be made in waterproof ink and will include the following:

- Name and address of field contact (on logbook cover)
- Date of entry
- Names and affiliations of personnel on the site

- General description of each day's field activities
- Documentation of weather conditions during sampling
- Location of sampling (e.g., borehole number and proximity to nearest landmark or topographic point of reference)
- Observations of sample or collection environment
- Identification of sampling device
- Any field measurements made, such as ambient air monitoring or headspace analysis of soil
- Sequence of collection of environmental samples
- Type of sample matrix (e.g., soil, groundwater)
- Date and time of environmental sample collection
- Field sample identification number
- Sample distribution (e.g., laboratory, hauler)
- Sampler's name
- Sample type (e.g., composite, normal, duplicate)
- For groundwater samples, which sample was filtered plus filter screen size and type
- Preservative used, if applicable, for the environmental sample.

3.5.3 Photographs

For each photograph taken, several items will be recorded on field photologs or in the field logbook:

- Date and time;
- Name of photographer;
- Name of site and field task;
- General direction faced and description of the subject;
- Location on site;
- Sequential number of the photograph and roll number.

All photographs should be taken with a recognizable object that can be used to provide scale information.

3.5.4 Field Forms

Field forms to be used during the Kotzebue LRRS RI/FS field investigation will include the field data, sample custody, and health and safety forms identified below:

Field Data Forms

- Boring Logs;
- Monitoring Well Construction Forms;
- Groundwater Sampling Forms;
- Field Data Sheets;
- Photo Logs.

Sample Custody Forms

- Chain-of-Custody Forms;
- Sample Labels and Custody Seals.

Health and Safety Forms

- Daily Tailgate Safety Meeting Form.

Examples of field forms to be used at Kotzebue LRRS are presented in Appendix B. The Field Operations Manager will keep a 3-ring notebook into which all field data sheets and accompanying

forms will be placed on a daily basis. All information entered into this notebook will be organized and maintained in chronologic order.

3.5.5 Corrections to the Field Logbook and Other Documents

All original data recorded in field logbooks, on sample tags, or in custody records, as well as other data sheet entries, will be written with waterproof ink. If an error is made on the document or in the logbook, corrections will be made simply by crossing a line through the error in such a manner that the original entry can still be read, and the correct information added as the change. All corrections will be initialed by the author and dated.

3.5.6 Sample Custody/Shipping Notebook

A sample custody/shipping notebook will be kept by the Field Operations Manager or their designee. This notebook will consist of a 3-ring notebook into which all chain of-custody forms and sample shipping receipts will be placed on a daily basis. All information entered into this notebook will be organized and maintained in chronologic order. Strict custody procedures will be maintained with the Sample Custody/Shipping Notebook. While being used in the field, this notebook will remain with the Field Operations Manager. Upon completion of the field effort, the Sample Shipping Notebook will be placed in a locked project filing cabinet in the office. Photocopies of pages from the notebook will be used as working documents.

3.5.7 Field Instrument Calibration Logbook

Dedicated calibration logbooks accompany each field instrument requiring calibration. The following information will be included in each calibration log:

- Project Name/Sample Event;
- Date and time of entry;
- Name of person(s) performing calibration;
- Calibration standard(s) used;
- Calibration results;
- Problems encountered during calibration.

3.6 SITE MANAGEMENT

The organization, functional responsibilities of key staff, levels of authority among key participants, and lines of communication during field investigation activities for this project are discussed in the following sections. Project organization and responsibilities for the project QA/QC program are presented in the Quality Assurance Project Plan (QAPP).

3.6.1 United States Air Force Project Personnel

Key USAF project personnel are identified below.

AFCEE Alaska Restoration Team Chief. Mr. Samer Karimi is the AFCEE Restoration Team Chief (RTC) and Contracting Officer's Representative (COR) for the RI/FS activities associated with the IRP site at Kotzebue LRRS. Contact Number: (210) 536-5297

611th Air Control Wing/Civil Engineer Squadron. Mr. Michael Rhoads is the Technical Representative providing project oversight for the 611th Civil Engineer Squadron (611 CES), Elmendorf AFB, Alaska. Mr. Rhoads is the base point of contact for the Kotzebue LRRS project. Contact Number: (907) 552-4532.

The 611 CES will provide logistical support to Tetra Tech, Inc. where appropriate, including installation building access authorization required for planned building inspections. The 611 CES will coordinate and conduct surveying activities at Kotzebue LRRS with the support of Tetra Tech, Inc. personnel.

AFCEE Technical Oversight Contractor. Booz-Allen, Inc. is the AFCEE contractor providing technical oversight for IRP activities conducted at Kotzebue LRRS. Mr. Bret Berglund is the Technical Representative responsible for oversight of the Kotzebue LRRS IRP project, and reports directly to the RTC, Mr. Karimi. Mr. Berglund is stationed at the 611 CES, Elmendorf AFB and provides technical support to the 611 CES through AFCEE. Contact Number: (907) 552-4532.

3.6.2 Tetra Tech, Inc. Project Personnel

Key Tetra Tech, Inc. personnel responsible for field activities to be conducted at Kotzebue LRRS are identified below.

Project Manager. Mr. Roderick A. Carr is the Project Manager for the Kotzebue LRRS work effort and is responsible for overall direction, coordination, and technical consistency of the Kotzebue LRRS project efforts. Contact Number: (206) 883-1912.

Technical Project Manager. Mr. Rick Osgood is the Technical Project Manager and is responsible for daily operations and technical project oversight, and reports directly to the Project Manager. Mr. Osgood coordinates with the 611 CES and AFCEE representatives, all subcontractors, and the Tetra Tech project team to ensure that all Kotzebue LRRS IRP project goals and objectives are met. Mr. Osgood will also act as liaison with federal, state, and local agencies, and will provide special notifications to all appropriate agencies (if required) and as approved by the Project Manager. He is responsible for the oversight, coordination, and successful implementation of project scoping documents. The Field Operations Manager and the Site Safety Officer will report directly to the Technical Project Manager. Contact Number: (206) 883-1912.

Field Operations Manager. Mr. David Hose is the Field Operations Manager and will be responsible for project field logistics and all field operations conducted by Tetra Tech at Kotzebue LRRS, including subcontractor oversight. He will be responsible for the proper implementation of the Sampling and Analysis Plan and will act to correct project and/or safety deficiencies identified in the field. Mr. Hose reports directly to the Technical Project Manager. Contact Number: (206) 883-1912.

Site Safety Officer. Mr. Randal Dyer is Tetra Tech's Site Safety Officer for the Kotzebue LRRS RI/FS effort, and reports directly to the Technical Project Manager. He will be responsible for the oversight and proper implementation of the Health and Safety Plan and will provide support to the Technical Project Manager and the Field Operations Manager to ensure that all requirements of The Health and Safety Plan are followed. As Site Safety Officer, he will establish the control zones and command post locations for each field activity, and will have the authority to temporarily suspend Tetra Tech onsite operations if eminent health hazards are identified. Appropriate health and safety corrective actions will be developed through consultation between the Technical Project Manager, the Field Operations Manager, the Site Safety Officer, and Tetra Tech's Regional Health and Safety Officer. Contact Number: (206) 883-1912.

Regional Health and Safety Officer. Ms. Carlotta Frommer is Tetra Tech's Regional Health and Safety Officer. Her responsibilities will be to review and approve the site health and safety plan and any subsequent changes to the plan. In addition, she will provide technical support to the Site Safety Officer as needed. If warranted, she will conduct site safety audits to ensure that the site health and safety plan is being implemented correctly. Contact Number: (206) 883-1912.

4.0 REFERENCES

Tetra Tech, Inc. 1994a. Draft Work Plan, Installation Restoration Program (IRP), Remedial Investigation/Feasibility Study, Kotzebue Long Range Radar Station (LRRS), Alaska. Prepared for the United States Department of the Air Force (AFCEE).

Tetra Tech, Inc. 1994b. Draft Quality Assurance Project Plan, Installation Restoration Program (IRP), Remedial Investigation/Feasibility Study, Kotzebue Long Range Radar Station (LRRS), Alaska. Prepared for the United States Department of the Air Force (AFCEE).

Tetra Tech, Inc. 1994c. Draft Health and Safety Plan, Installation Restoration Program (IRP), Remedial Investigation/Feasibility Study, Kotzebue Long Range Radar Station (LRRS), Alaska. Prepared for the United States Department of the Air Force (AFCEE).

U.S. Air Force. 1991. Handbook to Support the Installation Restoration program (IRP) Statements of Work - Volume I - Remedial Investigations/Feasibility Studies (RI/FS). Installation Restoration Program Division (YAQ), Human Systems Program Office, Human Systems Division (AFSC), Brooks Air Force Base, Texas. (Reprint 22 May, 1992).

Wiedemeier et al. 1994. (Draft) Technical Protocol for Data Collection and Modeling in Support of Intrinsic Remediation (Natural Attenuation) for Dissolved-Phase Fuel Contamination in Groundwater. Prepared for: Air Force Center for Environmental Excellence, Brooks Air Force Base, San Antonio, TX.

APPENDIX A - Lithologic Description and Logging

APPENDIX A

1.0 FIELD VISUAL SOIL CLASSIFICATION

1.1 General

All field logging of soils encountered during drilling and obtaining surficial samples will be performed in accordance with the procedures outlined in this section. Soil samples will be visually classified in the field in general accordance with the procedures of ASTM D 2488, Description and Identification of Soils Visual-Manual Procedure (Attachment 1). The ASTM procedure is based on the Unified Soil Classification System (USCS) and details several visual and/or manual methods which can be used in the field to estimate the USCS soil group or symbol for each sample.

1.2 Soil Description

Soil descriptions are entered on the logs of borings and surficial samples and include:

Coarse-Grained Soils	Fine-Grained Soils
USCS Name and Symbol	USCS Name and Symbol
Color	Color
Range in Particle Size	Consistency
Graduation (well, poorly)	Moisture Content
Density	Plasticity
Moisture Content	
Particle Shape	

Additional descriptions or information recorded for both coarse- and fine-grained soils includes: secondary materials, cobbles and boulders, and depth of change in soil type.

Definitions of some of the terms and criteria used to describe soils and conditions encountered during the investigations follow.

- a. **USCS Name and Symbol:** Soil names are derived from Table 1, the Unified Soil Classification System.

The soils are first designated as coarse- or fine-grained. Coarse-grained soils are those in which more than half (by weight) of the particles are visible to the naked eye. In making this estimate, particles coarser than 3 in. (76 mm) in diameter are excluded. Fine-grained soils are those in which more than half (by weight) of the particles are so fine that they cannot be seen by the naked eye. The distinction between coarse- and fine-grained can also be made by sieve analysis with the number 200 sieve (.074 mm) size particle. The coarse-grained soils are further divided

into sands and gravels by estimating the percentage of the coarse fraction larger than the number 4 sieve (about 1/4 inch or 5 mm). Each coarse-grained soil is then qualified as silty, clayey, poorly graded, or well graded as discussed under plasticity and gradation.

Fine-grained soils are identified in the field as clays or silts with appropriate adjectives (clayey silt, silty clay, etc.) based on the results of dry strength, dilatancy, and plastic thread tests (see ASTM D 2488 for details of these tests).

Dual USCS symbols and adjectives may be used to describe soils exhibiting characteristics of more than one USCS group.

- b. Color: Color descriptions are recorded using the Munsell Color Chart. Both the color number and name should be recorded. Color should be determined on moist samples. Several colors may be present in samples. These secondary colors and their conformation should also be described. For example, reddish yellow (7.5 YR 7/6) with dark yellowish brown (10 YR 4/4) streaks.
- c. Range in Particle Size: For coarse-grained soils (sands and gravels), the size range of the particles visible to the naked eye is estimated as fine, medium, coarse, or a combined range (fine to medium), as defined below.

Major Soil Type Division	Texture	Grain Size Range
Gravel	Coarse	3/4 to 3" (19 to 75 mm)
	Fine	1/4 to 3/4" (5 to 19 mm)
Sand	Coarse	0.08 to 1/4" (2 to 5 mm)
	Medium	0.02 to 0.08" (0.4 to 2 mm)
	Fine	0.003 to 0.02" (0.07 to 0.4 mm)

- d. Gradation: Well graded indicates a coarse-grained soil which has a wide range in grain size and substantial amounts of most intermediate particle sizes. A coarse-grained soil is identified as poorly graded if it consisted predominantly of one size (uniformly graded) or had a wide range of sizes with some intermediate sizes obviously missing (gap-graded).
- e. Density or Consistency: The density or consistency of the in-place soil is estimated on the number of blows required to advance the sampler or the drilling rate (difficulty) and/or hydraulic pulldown needed to drill. For fine-grained soils, the field guides to shear strength presented below are also used to estimate consistency.

- Coarse-grained soils - GW, GP, GM, GC, SW, SP, SM, SC (Gravels and Sands)

Consistency	N-Value (ASTM D 1586-67), Blows/Foot
Very Loose	0 - 4
Loose	4 - 10
Medium-Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

- Fine-grained Soils - ML, MH, CL, CH (Silts and Clays)

Consistency	Shear Strength (ksf)	Field Guide
Very Soft	<0.25	Sample with height equal to twice the diameter, sags under own weight
Soft	0.25-0.50	Can be squeezed between thumb and forefinger
Firm	0.50-1.00	Can be molded easily with fingers
Stiff	1.00-2.00	Can be imprinted with slight pressure from fingers
Very Stiff	2.00-4.00	Can be imprinted with considerable pressure from fingers
Hard	Over 4.00	Cannot be imprinted by fingers

- f. Moisture Content: The following guidelines are used in the field for describing the moisture in the soil samples:

Dry No feel of moisture
 Slightly Moist Much less than normal moisture
 Moist Normal moisture for soil
 Very Moist Much greater than normal moisture
 Wet At or near saturation

- g. Particle Shape: The following guidelines are used to estimate particle shape in coarse-grained soils:

Angular Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular Particles are similar to angular but have somewhat rounded edges
Subrounded Particles exhibit nearly plane sides but have well-rounded corners and edges
Rounded Particles have smoothly curved sides and no edges

- h. Secondary Material: Secondary materials are those which constitute the minor fraction in the sample. For example, the silt in a silty sand. Descriptions of these materials should include all textural descriptions possible (and relevant) such as range in particle size, gradation, and particle shape for sands and gravels. Designations for the amount of the secondary materials are listed below:

Trace 5-12% (by dry weight)
Little 13-20% (by dry weight)
Some >20% (by dry weight)

- i. Cobbles and Boulders: A cobble is a rock fragment, usually rounded or subrounded, with an average diameter between 3 and 12 inches (76 and 305 mm). A boulder is a rock fragment, usually rounded by weathering or abrasion, with an average diameter of 12 inches (305 mm) or more. The presence of cobbles and/or boulders is identified by noting the sudden change in drilling difficulty or cuttings in borings or by visual observation in excavations. An estimate of the size, range, and percentage of cobbles and/or boulders in the strata should be recorded on the logs.

- j. Depth of Change in Soil Type: During drilling of borings, the depth of changes in soil type are determined by observing samples, drilling rates, changes in color or consistency of drilling fluid, and relating these to depth. All soil type interfaces were recorded on the logs.

In addition to the observations recorded relating to soil descriptions, remarks concerning drilling difficulty, water levels encountered, and other unusually conditions should be recorded on the logs.

2.0 CLASSIFICATION PROCEDURE

The field classification procedure is listed below and consists of a process of elimination. All pertinent description information should be noted while performing these steps.

- a. Obtain a representative sample of the soil.
- b. Estimate the size of the largest particle.
- c. Remove the boulders and cobbles, particles larger than 3 inches, and estimate the amount, percentage by weight, in the total sample.

- d. Spread the dry sample on a flat surface or in the palm of the hand, and classify as coarse-grained or fine-grained. Individual grains of a coarse-grained soil can be distinguished with the unaided eye, whereas the individual grains of the fine fraction cannot.
- e. If coarse-grained, classify as gravel or sand by criteria shown on the table.
- f. If gravel or sand, classify as "clean" or "with appreciable fines." Fines are the fraction smaller than 0.074 mm (No. 200 sieve).
- g. If the gravel or sand is clean, decide if it is well-graded (W) or poorly graded (P), and assign the appropriate group name (GW, GP, SW, or SP).
- h. If the gravel or sand contains appreciable fines, decide if the fines are silty (M) or clayey (C), and classify as GM, GC, SM, or SC. Fine sand may be distinguished from silt and clay by rubbing a small amount between the fingers. Silt or clay feels smooth and will leave a stain, whereas fine sand feels gritty and will not stain the fingers.
- i. For fine-grained soils or the fine-grained portion of a coarse-grained soil, the dilatancy, dry strength, and toughness tests are performed in accordance with instructions in Attachment 2. In addition, observations of color and odor are important, particularly for organic soils (OL and OH groups are drab shades of gray, brown, or almost black and have a distinctive odor). Through the process of elimination and the use of the field test results, these soils are then given the proper group symbol and descriptive identification.
- j. Highly organic soils (Pt) are characterized by undecayed particles of leaves, sticks, grass, and other vegetable matter giving the soil a fibrous texture. They are spongy, dull brown to black in color, and have a characteristic odor. Low-lying, swampy areas usually contain highly organic soils.
- k. Soil which have characteristics of two groups are given boundary classification using a name most nearly describing the soil, and the two group symbols are such as GW-GC. Boundary classifications are used when between and equal to 5 and 12% of fine material size is present (ie., 55% gravel, 35% sand, 10% fines is GM GP).

ATTACHMENT

FIELD IDENTIFICATION PROCEDURES FOR FINE-GRAINED SOILS OR FRACTIONS

These procedures are to be performed on the minus No. 40 sieve size particles (approximately 1/64 inch size). For field classification purposes remove by hand the coarse particles that interfere with the tests.

DILATANCY (Reaction to Shaking)

After removing particles larger than No. 40 sieve size, prepare a pat of moist soil with a volume of about one-half cubic inch. Add enough water, if necessary, to make the soil soft but not sticky.

Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens, and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

DRY STRENGTH (Crushing Characteristics)

After removing particles larger than No. 40 sieve size, mold a pat of soil the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun, or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH Group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

TOUGHNESS (Consistency Near Plastic Limit)

After removing particles larger than the No. 40 sieve size, a specimen of soil about one-half inch cube in size is molded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about one-eighth inch in diameter. The thread is then folded and rerolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.

After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as Kaolin type clays and organic clays which occur below the A-line.

Highly organic clays have a very weak and spongy feel at the plastic limit.

EAR TEST

Moisten a sample and rub between thumb and index finger close to ear.

- | | | | |
|----|----------------|---|--------------------|
| a. | Abrasive sound | - | Predominately silt |
| b. | No sound | - | Predominately clay |

WATER IN JAR TEST

Place sample in small jar of water and shake until thoroughly mixed. Let dispersed sample stand for period of time.

- | | | | |
|----|-----------------------|---|--------------|
| a. | Quick settlement time | - | Sand or silt |
| b. | Long settlement time | - | Clay |

SHINE TEST

The surface of a lump of dry or slightly moist soil is stroked, under strong pressure, with the flat of a knife blade or with a fingernail. If the surface becomes shiny, the soils is a clay of high plasticity. With silts the surface remains dull.

APPENDIX B - Tetra Tech, Inc. Field Forms



TETRA TECH, INC.

DAILY TAILGATE SAFETY MEETING FORM

Date: _____ Time: _____ Job Number: _____
Client: _____
Site Location: _____
Scope of Work: _____

SAFETY TOPICS PRESENTED

Planned Field Activities for the Day: _____

Protective Clothing/Equipment: _____

Chemical Hazard: _____

Physical Hazards: _____

Special Equipment: _____

Decontamination Procedures: _____

Other: _____

Emergency Procedures: _____

Hospital: _____ Phone: _____ Ambulance Phone: _____

Hospital Address and Route: _____

Employee Questions/Comments: _____

ATTENDEES

NAMED PRINTED

SIGNATURE

Meeting Conducted By:

Name Printed/Signature

Site Safety Coordinator

Name Printed/Signature

Project Manager



TETRA TECH, INC.

FIELD DATA SHEET

DATE	
TIME	
SHEET	OF

PROJECT NAME		PROJECT NO.	
FIELD ACTIVITY SUBJECT			
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS			
WEATHER CONDITIONS		VISITORS ON SITE	
		Tt PERSONNEL ON SITE	
SIGNATURE		DATE	



TETRA TECH, INC.

PHOTO LOG

DATE	
SHEET	OF

Photo # _____

Photographer _____

Date _____

Description _____

Photo # _____

Photographer _____

Date _____

Description _____

Photo # _____

Photographer _____

Date _____

Description _____

Photo # _____

Photographer _____

Date _____

Description _____

Photo # _____

Photographer _____

Date _____

Description _____

Photo # _____

Photographer _____

Date _____

Description _____

Photo # _____

Photographer _____

Date _____

Description _____

Photo # _____

Photographer _____

Date _____

Description _____

Photo # _____

Photographer _____

Date _____

Description _____

Photo # _____

Photographer _____

Date _____

Description _____



TETRA TECH, INC.

GEOLOGIC LOG OF EXPLORATION

LOCATION OF SKETCH

(Show dimensions to mapped features)



SURFACE ELEVATION _____ DATUM _____

CLIENT/OWNER: _____
TETRA TECH PROJECT NUMBER: _____
EXPLORATION NUMBER: _____
START DATE: _____
GROUND SURFACE CONDITIONS: _____
CONTRACTOR REPRESENTATIVE: _____
EXPLORATION CONTRACTOR: _____
OPERATOR: _____
DRILL TYPE/METHOD: _____
HAMMER WEIGHT & STROKE: _____

CASING DEPTH	CASING DRIVE RESISTANCE	SAMPLE NUMBER	PENETRATION RESISTANCE/6"	LENGTH DRIVEN	SAMPLE LENGTH RECOVERED	DEPTH (FT)	GRAPHIC RECOVERY	DEPTH SCALE	UNIFIED SYMBOL
								0	
								1	
								2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
								0	
								1	
								2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
								0	

WATER LEVEL INFORMATION

DATE				
TIME				
DEPTH OF WATER				
HOLE DEPTH				
CASING DEPTH				

DESCRIPTION OF STRATIGRAPHY

NOTE: Add 'C' to sample type if a catcher is used.

FINISHED DATE: _____ HOUR: _____ OR CONTINUED: _____



WELL COMPLETION SPECIFICATIONS

DRILLING COMPANY:

• DRILLERS:

TYPE OF RIG:

DATE:

FIELD GEOLOGIST:

(SIGNATURE):

WELL NUMBERS:

GROUND ELEVATION:

START OF DRILLING
(DAY/TIME):

FINISH OF
WELL DEVELOPMENT
(DAY/TIME):

NOMINAL HOLE DIAMETER:

CASING TYPE:

CASING SIZE (ID):

SCREEN TYPE:

SLOT SIZE:

WELL DEV. METHOD:

GROUNDWATER MEASUREMENTS

DATE/TIME:

DEPTH(TOC):

ELEVATION:

DATUM:

HYDRAULIC
CONDUCTIVITY
TEST METHOD:

SATURATED
HYDRAULIC
CONDUCTIVITY:

HEIGHT OF MONUMENT:	DEPTH (FT)
HEIGHT OF CASING:	0
GROUND SURFACE:	

Denote on diagram: location and thickness of annular fill material,
screened interval(s), product and water levels.

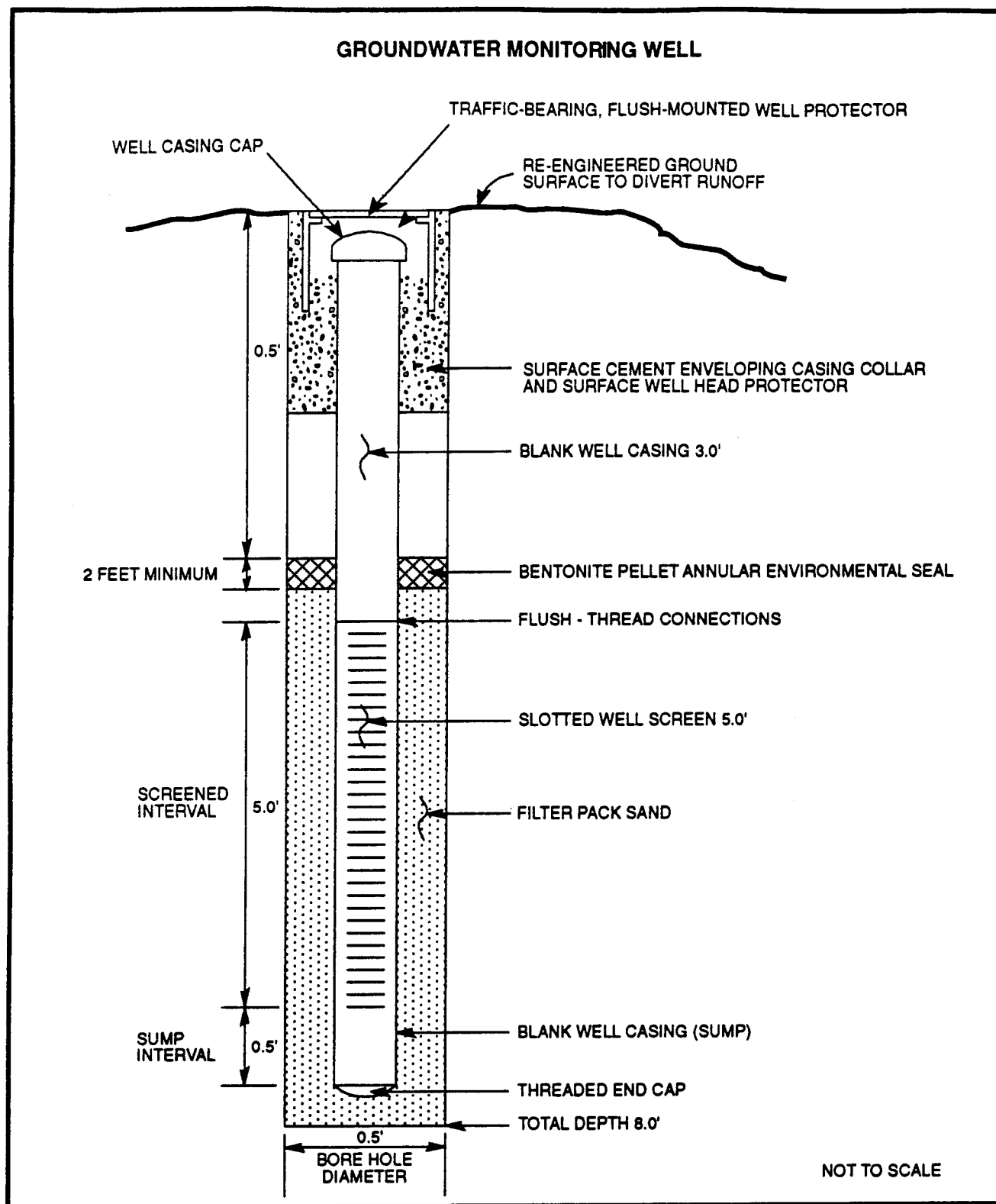


Figure Well Construction Diagram Monitoring Well B-1.



CHAIN OF CUSTODY

DOCUMENT

[illegible]